Appendix N

Additional Evaluation of Wildlife Habitat Conservation Measures

I. Introduction

This appendix provides a summary of additional analyses pertaining to the wildlife habitat conservation measures of FEIS alternatives, with emphasis on the old-growth habitat conservation strategy adopted for the Revised Forest Plan (FEIS Alternative 11). Included are an explanation and overview of a second set of panel assessment meetings held in March and April 1997, a comparison of the results of these panels with the analysis contained in Chapter 3 of the FEIS, and discussions of how this and other information was used in strengthening the Forest Plan (Sections II and III of this appendix). Section IV is a detailed analysis of the old-growth forest habitat conservation strategy of the Forest Plan; how it was developed, its relationship to other proposed strategies, and its effectiveness in providing the amount and distribution of habitat sufficient to maintain viable and well distributed wildlife populations of old-growth associated species across the Tongass National Forest. Section IV also contains additional evaluations of the viability strategies for the Alexander Archipelago wolf and Queen Charlotte goshawk. Section V lists all references cited.

II. Panel Assessment Process and Analyses

A. Panel Process

In the Final Environmental Impact Statement (FEIS), Alternatives 10 (Forest Supervisors' preferred alternative in the Revised Supplement to the Draft Environmental Impact Statement) and 11 (FEIS Preferred Alternative), were not subjected to risk assessment panels as were the full array of draft alternatives (Alternatives 1, 2, 3, 4, 5, 6, 7, 8, and 9). In the description and analysis of panel results in the FEIS (Chapter 3, Biodiversity and Wildlife sections), there was a strong correlation between the acres of productive old-growth (POG) scheduled for harvest in an alternative and the mean outcome scores for that alternative. As the number of acres harvested increased among alternatives, the mean outcome scores also increased, resulting in greater risk that habitat may not be sufficient to maintain viable and well distributed populations.

Based upon this strong relationship that emerged, the likely effects of Alternatives 10 and 11 were inferred from the acres of old-growth forest scheduled for harvest in these two alternatives, the features of these alternatives as compared to the paneled alternatives, and the relative importance of these features as judged from panel discussions for individual species. Using this approach the likely effects of Alternatives 10 and 11 were discussed in the Biodiversity and Wildlife sections of the FEIS. Because this strong relationship facilitated development of an effects analysis and time and expense of reconvening all panels was a consideration, alternatives 10 and 11 were not originally subjected to panel risk assessment.

To examine if these inferences were appropriate and presented an accurate analysis of likely effects of implementing Alternatives 10 and 11, a second set of risk assessment panels was conducted in March and April 1997. This second set of six risk assessment panels included the northern (Queen Charlotte) goshawk, Alexander Archipelago wolf, brown bear, American marten, fisheries resources, and other terrestrial mammals. These panels followed the same process described in the FEIS (Chapter 3, Biodiversity, Fish and Wildlife sections) for panels conducted in late 1995 and early 1996.

The panels were conducted with a modification of the Delphi process that was used, tested, and judged effective in the President's Northwest Forest Plan. The panels were designed to evaluate various alternatives for the likelihood of maintaining sufficient, well distributed habitat to maintain viable populations of old-growth associated wildlife species over the 100-year planning horizon.

In addition to Alternatives 10 and 11, the following alternatives also were assessed to provide a context to help interpret panel results: 1, 2, 5, 9 (1979 Forest Plan), 9' (1979 Forest Plan with updated Geographic Information System timber suitability layers), and the historic forest condition (pre-1954) prior to large-scale commercial timber harvest. From a science process standpoint, this array of alternatives was deemed sufficient to aid with interpretation of results for Alternatives 10 and 11.

Panel evaluators were instructed to evaluate the effect that implementation of TLMP alternatives 1, 2, 5, 9, 9', 10, or 11 for 100 years would have on the abundance and distribution of habitats suitable to support well distributed and persistent populations of species assessed. One hundred likelihood outcome points were distributed among five possible outcomes (see Biodiversity and Wildlife sections in FEIS) In addition, panel evaluators were asked to appraise features used to construct alternatives (e.g. reserves, beach buffers) as to their contribution to maintaining habitat for species assessed. These qualitative appraisals of specific features and the panel discussions were used by the authors of the written summaries prepared for each panel, to interpret the quantitative evaluation of alternatives as indicated by the assignment of likelihood points by outcome and to identify important ecological considerations. (Summary reports for each panel are included in the planning record.)

In the presentation of panel assignment of likelihood outcome points in each table below, the ‘after’ likelihood outcome ratings are used to compare among alternatives since these second ratings benefit from professional interaction and a likely greater understanding of differences among features in alternatives. The ‘before’ ratings occurred following presentations on alternatives and local information on each species, but before the merits of individual alternatives were discussed among panel evaluators. The average rating for all panelists also is used, rather than focusing on differences among individual evaluators.

B. Concepts of Viable and Well Distributed Populations

In the discussion and analysis of the first set of panel results in the FEIS, Outcomes I and II were often combined as an expression of likelihood of sustaining habitat sufficient to support viable and well distributed populations. Conversely, Outcomes III, IV, and V were often combined in effects analysis as representing increased risks of not maintaining the habitat necessary to sustain viable and well distributed populations. By virtue of its description, Outcome III was difficult to interpret due to the statement that “significant gaps” would be created and the “significance of gaps must be judged relative to the species distributional range, and life history.” There was considerable variability in the interpretation of this concept by individual panelists. The original panelists convened in late 1995 and early 1996 were not specifically queried about the relationship between outcomes and the maintenance of viable well-distributed populations. These conclusions were generally inferred, based largely upon whatever discussion occurred during panel deliberations. In general, the interdisciplinary planning team (IDT) inferred that Outcome III represented a condition where gaps were significant enough to substantially preclude interaction among populations of the species. In this condition, a species would not be well distributed, and continued existence of the species across the planning area would be at risk.

Because of the difficulty the IDT encountered in interpreting the first set of panel results relative to the maintenance of well distributed and viable populations, the second set of panelists were provided an opportunity to directly and explicitly discuss these issues. The same five outcomes were used in the second panels conducted in 1997. However, focused discussion provided additional information relative to Outcome III and the panelists’ interpretation of gaps in distribution, well distributed populations, and viability.

Outcome III, defined as providing habitat to maintain breeding populations but with significant gaps in historic distribution, was interpreted as an array of conditions. For some of the panels, one end of this array was any condition where gaps in habitat existed as small as the territory of a single animal or single pair of animals of the species being assessed. At the other end, this array could include conditions with broad gaps in habitat distribution and significant limitations on population interactions. The panelists considered some part of this array of conditions as meeting their concept of viable and well distributed. They indicated that the concepts of well distributed and viable, as they used them for the purposes of assessing risk, were not necessarily synonymous. Their views on well distributed habitat dealt primarily with the likelihood that modified habitat would, because of gaps, no longer be able to support a continuous territory-to-territory distribution of resident individuals or groups. That is, some previously occupied territories might become permanently vacant within a 100-year timeframe.

The panelists interpreted viability as a condition in which populations could continue to interact and interbreed within their historic distribution across the Tongass National Forest. They felt that a distribution that included some gaps could still be considered viable as long as there was still interaction among the population segments on the forest and those population segments were distributed across the species range. For example, the marten panel understood that their concept of a habitat gap being as wide as a previously occupied home range likely had little if any effect on species interaction or interbreeding. Thus, in the panelists' interpretation, the criterion of well distributed was more restrictive than the criterion of viable.

The panelists were not providing a legal interpretation of the requirement in the NFMA regulations to provide for viable populations. In the discussion of population viability in the NFMA regulations, the concept of "well-distributed" is tied to the ability to continue interactions among individuals of a species, not necessarily to the maintenance of a territory-to-territory distribution of the species. The interpretation of well distributed is expressed most clearly in the stipulation that maintenance of a viable population requires providing habitat to support "at least a minimum number of reproductive individuals and that habitat must be well distributed so that those individuals can interact with others in the planning area" (36 CFR 219.19). This has been interpreted to mean that the condition of viable and well distributed allows for gaps within a species distribution as long as the population segments of the species continue to interact and are distributed throughout the planning area. Thus, the concept of well distributed used by the panelists was more stringent than the concept as applied in the NFMA regulations.

It is difficult to determine how many likelihood points were assigned to the outcome of a viable population since the panelists considered that only some part of the array of conditions under Outcome III met their definition of viable. Thus, the likelihood of maintaining habitat sufficient to support well distributed and viable populations is appropriately presented as being within the span of scores that bracket Outcome III. Consequently, in some of the tables in the following discussions, ratings are expressed as being greater than the sum of likelihood scores for Outcomes I and II, but less than the sum of likelihood scores for Outcomes I, II and III. Expression of data as a range also illustrates the uncertainty in the process and the variability in the professional judgments regarding the concepts of viable and well distributed populations. Use of a range also avoids presenting a single absolute value that might suggest a level of precision that does not exist in this assessment process.

Finally, in the some of the following tables, 1995 and 1996 panel outcome scores are expressed in the same manner of bracketing scores as for the 1997 scores discussed above. Expression of the first panel information in this manner is for comparative purposes only. These combinations do not infer any conclusions on behalf of the 1995/1996 panels because they did not specifically discuss viable and well distributed populations relative to the specific outcomes.

III. Discussion of Panel Results and Other Information on Species Habitat Outcomes

A. Relationship of 1997 Panel Results to Analyses in FEIS Chapter 3

1. Assessment of Fish Species

Results of the panel assessments conducted in 1997 generally confirmed the outcomes for fish species described in FEIS Chapter 3. For fish species, the range of variation for alternatives assessed in both 1995 and 1997 was 1 to 16 points, and the ranking of these alternatives remained identical. Of those alternatives reviewed in both 1995 and 1997, Alternatives 1, 5, 2, and 9' were ranked in order from least to highest risk to fish habitat in both of the assessments. The ranking of all alternatives in Chapter 3 (FEIS 3-63), based on the 1995 panels and an approximation for Alternatives 10 and 11, is also consistent with the results of the 1997 panels. In both cases, Alternative 11 with riparian option 2a is ranked between Alternatives 1 and 5 and Alternative 10 is placed between 5 and 2. The full rank order of the alternatives, from least to greatest risk, is 1, 11, 5, 4, 3, 10, 6, 2, 9, 9', and 7.

2. Assessment of Terrestrial Vertebrate Species

The 1997 panel assessment of terrestrial vertebrates also generally confirmed the outcomes described in Chapter 3. However, comparison between Chapter 3 and the 1997 panels is more complex for terrestrial vertebrates than for fish, and some differences were noted. Results for each species or group are discussed below.

a. Northern Goshawk

Variation in ratings for alternatives assessed in both 1995 and 1997 ranged up to 18 points based on the sum of likelihood points assigned to Outcomes I, II and III (Table 1). Of those alternatives reviewed in both 1995 and 1997, Alternatives 1, 5, 2, and 9' were ranked in order (based on average weighted outcomes-see Chapter 3) from least to highest risk to goshawk habitat in both of the assessments. The 1997 panels also confirm the judgment in Chapter 3, based on a detailed analysis of VCU's, that Alternatives 5 and 11 have the highest likelihood of sustaining goshawk habitat across the forest of all alternatives that propose to continue timber harvest. However, the analysis in Chapter 3 resulted in a conclusion that Alternative 11 had a slightly higher likelihood of maintaining goshawk habitat than Alternative 5. The panel evaluators convened in 1997 rated Alternative 5 somewhat higher than Alternative 11. Additional measures applied to Alternative 11 subsequent to the evaluations would make overall outcomes for the two alternatives even more similar. Those additional measures are described in a following section (subpart B.). Further discussion of the effects of the Forest Plan on goshawks is presented in Section IV of this appendix.

Table 1.
Northern Goshawk Panel Results[1].

	Alternatives							
Outcomes	**1**	**2**	**5**	**9**	**9'**	**10**	**11**	**Historic**
A. 1997 Panels								
I	63	1	35	0	0	8	23	89
II	38	19	50	10	8	40	48	11
III	0	61	15	61	61	48	28	0
IV	0	16	0	26	29	5	3	0
V	0	5	0	3	3	0	0	0
POG Harvest	0	853,270	462,880	1,042,428	1,402,800	670,270	475,000	-414,000
B. 1995 Panels								
I	66	0	23		0			
II	31	24	51		23			
III	3	40	25		43			
IV	0	33	1		33			
V	0	4	0		3			
POG Harvest	0	1,106670	572,300		1,402,800			
C. Range Between Outcomes I + II and I + II + III								
Panel Year								
1997	100	>20, <61	>85, <100	>10, <61	>8, <61	>48, <96	>71, <97	100
1995	>97, 100	>24, <64	>74, <99		>23, <66			

[1] Mean likelihood outcome scores for the northern goshawk by evaluators on the Northern Goshawk Assessment Panel in 1997 are shown in A. Scores from the 1995 panel also are shown in B. for alternatives common to both rating periods for comparison purposes. Alternatives 1 and 9' are identical in features and acres of POG harvested. Alternatives 2 and 5 are identical in features but with fewer acres of POG harvested. A range for all alternatives is shown in C. for the likelihood of maintaining habitat to support viable and well distributed goshawk populations. Only 'after' scores are shown. The -414,000 value for POG harvest under Historic represents the acreage harvested since 1954.

b. American Marten

Of those alternatives reviewed in both 1995 and 1997, Alternatives 1, 5, 2, and 9' were ranked in order from least to highest risk to marten habitat in both assessments (Table 2). The 1997 panel results also are consistent with conclusions drawn concerning the relative ranking of all alternatives based on other evidence in Chapter 3 and other information in the planning record. This includes the conclusion that outcomes of Alternative 11 would be similar to those of Alternative 3.

Table 2.
American Marten Panel Results[1].

	Alternatives							
Outcomes	**1**	**2**	**5**	**9**	**9'**	**10**	**11**	**Historic**
A. 1997 Panels								
I	84	0	1	0	0	0	0	90
II	9	19	65	13	11	30	36	9
III	8	64	29	53	50	59	55	1
IV	0	18	5	35	39	11	9	0
V	0	0	0	0	0	0	0	0
POG Harvest	0	853,270	462,880	1,042,428	1,402,800	670,270	475,000	-414,000
B. 1995 Panels								
I	54	3	18		3			
II	25	5	53		6			
III	21	56	24		46			
IV	0	21	6		24			
V	0	15	0		21			
POG Harvest	0	1,106670	572,300		1,402,800			
C. Range Between Outcomes I + II and I + II + III								
Panel Year								
1997	>93, <100	>19, <83	>66, <95	>13, <66	>11, <61	>30, <89	>36, <91	>99, 100
1995	>79, <100	>8,<64	>71, <95		>9, <55			

[1] Mean likelihood outcome scores for the marten by evaluators on the Marten Assessment Panel in 1997 are shown in A. Scores from the 1995 panel also are shown in B. for alternatives common to both rating periods. Alternatives 1 and 9' are identical in features and acres of POG harvested. Alternatives 2 and 5 are identical in features but with fewer acres of POG harvested. A range for all alternatives is shown in C. for the likelihood of maintaining habitat to support viable and well distributed marten populations. Only 'after' scores are shown. The -414,000 value for POG harvest under Historic represents the acreage harvested since 1954.

c. Alexander Archipelago Wolf

Overall, the results of the 1995 and 1997 evaluations were consistent. Of those alternatives reviewed in both 1995 and 1997, Alternatives 1, 5, 2, and 9' were ranked in order from least to highest risk to wolf habitat in both assessments (Table 3). In the 1997 evaluation, Alternatives 11, 10, and 5 were all given relatively high ratings, and these were similar to ratings given to Alternative 3 in 1995. These results are consistent with the discussion of alternatives in Chapter 3, except that the analysis in Chapter 3 clearly distinguishes Alternative 11 as the most favorable for wolves among the alternatives that propose to continue timber harvest, primarily due to the more extensive reserve system in Alternative 11. Further discussion of the effects of the proposed plan on wolves is presented in Section IV of this appendix.

Table 3.
Alexander Archipelago Wolf Panel Results[1].

				Alternatives				
Outcomes	**1**	**2**	**5**	**9**	**9'**	**10**	**11**	**Historic**
				A. 1997 Panels				
I	88	20	55	18	18	54	58	89
II	6	43	29	30	30	26	25	8
III	3	34	13	44	44	16	14	1
IV	3	3	3	6	6	3	3	1
V	1	1	1	3	3	1	1	1
POG Harvest	0	853,270	462,880	1,042,428	1,402,800	670,270	475,000	-414,000
				B. 1995 Panels				
I	80	35	48		3			
II	14	25	34		31			
III	3	30	16		48			
IV	2	9	1		18			
V	1	1	1		1			
POG Harvest	0	1,106670	572,300		1,402,800			
				C. Range Between Outcomes I + II and I + II + III				
Panel Year								
1997	>94, <97	>63, <97	>84, <97	>48, <92	>48, <92	>80, <96	>83, <97	>97, <98
1995	>94, <97	>60, <90	>82, <98		>34, <82			

[1] Mean likelihood outcome scores for the wolf by evaluators on the Wolf Assessment Panel in 1997 are shown in A. Scores from the 1995 panel also are shown in B. for alternatives common to both rating periods. Alternatives 1 and 9' are identical in features and acres of POG harvested. Alternatives 2 and 5 are identical in features but with fewer acres of POG harvested. A range for all alternatives is shown in C. for the likelihood of maintaining habitat to support viable and well distributed wolf populations. Only 'after' scores are shown. The -414,000 value for POG harvest under Historic represents the acreage harvested since 1954.

d. Brown Bear

Overall, the results of the 1995 and 1997 evaluations were consistent. Of those alternatives reviewed in both 1995 and 1997, Alternatives 1, 5, 2, and 9' were ranked in order from least to highest risk to brown bear habitat in both assessments (Table 4). However, the panel results suggest that Alternatives 5 and 11 would produce similar outcomes for brown bears, while analysis based on the components of the alternatives (Chapter 3) indicates that Alternative 11 is more effective than Alternative 5 in reducing risk to bears. Alternative 11 has a much greater reserve system than Alternative 5, including additional large reserves on Northeast Chichagof island in a landscape that was identified as high risk by the 1995 panels. In addition, Alternative 11 provides more substantial riparian protection than Alternative 5, and this feature was identified as important for bears.

Table 4.
Brown Bear Panel Results [1].

	Alternatives							
Outcomes	**1**	**2**	**5**	**9**	**9'**	**10**	**11**	**Historic**
A. 1997 Panels								
I	16	0	0	0	0	0	0	81
II	78	49	65	16	16	56	68	19
III	6	41	33	63	59	33	25	0
IV	0	10	3	21	25	11	8	0
V	0	0	0	0	0	0	0	0
POG Harvest	0	853,270	462,880	1,042,428	1,402,800	670,270	475,000	-414,000
B. 1995 Panels								
I	40	4	8		0			
II	53	35	59		14			
III	8	38	34		45			
IV	0	24	0		41			
V	0	0	0		0			
POG Harvest	0	1,106670	572,300		1,402,800			
C. Range Between Outcomes I + II and I + II + III								
Panel Year								
1997	>94, <100	>49, <90	>65, <98	>16, <74	>16, <75	>56, <89	>68, <93	100
1995	>93, <100	>39, <77	>67, <100		>14, <59			

[1] Mean likelihood outcome scores for the brown bear by evaluators on the Brown Bear Assessment Panel in 1997 are shown in A. Scores from the 1995 panel also are shown in B. for alternatives common to both rating periods. Alternatives 1 and 9' are identical in features and acres of POG harvested. Alternatives 2 and 5 are identical in features but with fewer acres of POG harvested. A range for all alternatives is shown in C. for the likelihood of maintaining habitat to support viable and well distributed brown bear populations. Only 'after' scores are shown. The -414,000 value for POG harvest under Historic represents the acreage harvested since 1954.

e. Other Terrestrial Mammals

There was general consistency in the 1995 and 1997 evaluations of other terrestrial mammals, although there was variation in the ratings assigned to alternatives by the two panels. Of those alternatives reviewed in both 1995 and 1997, Alternatives 1, 5, 2, and 9' were ranked in order from least to highest risk to habitat of the widely-distributed group in both assessments (Table 5). Differences between Alternatives 2 and 9' were slight in both assessments. Additionally, ratings of all these alternatives improved substantially from the 1995 to the 1997 assessment. The same pattern held true for the endemic mammal group (Table 6). Relative rankings of the four alternatives reviewed by both panels remained constant, but the ratings for each of the alternatives improved from the first to the second panel. These results also generally support the conclusion drawn in Chapter 3 that, of the alternatives that propose to continue harvesting timber, Alternative 11 poses the least risk to these species groups. However, the difference for these species between Alternative 11, as evaluated by the panelists, and Alternative 5 is small. Subsequent to the assessment by the panelists, additional measures were added to Alternative 11 to benefit these species groups.

Table 5.
Widely Distributed Mammals Group Panel Results [1].

	Alternatives							
Outcomes	**1**	**2**	**5**	**9**	**9'**	**10**	**11**	**Historic**
A. 1997 Panels								
I	24	0	3	0	0	3	10	75
II	45	3	36	0	0	23	28	17
III	28	15	53	9	4	53	44	7
IV	4	68	6	68	70	19	16	1
V	0	15	3	24	26	4	3	0
POG Harvest	0	853,270	462,880	1,042,428	1,402,800	670,270	475,000	-414,000
B. 1995 Panels								
I	13	0	5		0			
II	20	5	18		3			
III	18	11	16		9			
IV	43	30	51		29			
V	8	54	10		60			
POG Harvest	0	1,106670	572,300		1,402,800			
C. Range Between Outcomes I + II and I + II + III								
Panel Year								
1997	>69, <96	>3, <18	>39, <92	>0, <9	>0, <4	>26, <79	>38, <82	>92, <99
1995	>33, <51	>5, <16	>23, <39		>3, <12			

[1] Mean likelihood outcome scores for the widely distributed mammals by evaluators on the Other Terrestrial Mammals Assessment Panel in 1997 are shown in A. Scores from the 1995 panel also are shown in B. for alternatives common to both rating periods. Alternatives 1 and 9' are identical in features and acres of POG (POG) harvested. Alternatives 2 and 5 are identical in features but with fewer acres of POG harvested. A range for all alternatives is shown in C. for the likelihood of maintaining habitat to support viable and well distributed populations of widely distributed mammals. Only 'after' scores are shown. The -414,000 value for POG harvest under Historic represents the acreage harvested since 1954.

Table 6.
Endemic Mammals Group Panel Results [1].

Outcomes	1	2	5	9	9'	10	11	Historic
				Alternatives				
A. 1997 Panels								
I	6	0	1	0	0	1	3	59
II	34	0	9	0	0	13	16	26
III	31	8	45	8	4	34	36	13
IV	28	70	41	71	73	46	41	2
V	1	23	4	21	24	6	4	0
POG Harvest	0	853,270	462,880	1,042,428	1,402,800	670,270	475,000	-414,000
B. 1995 Panels								
I	13	0	5		0			
II	20	5	18		3			
III	18	11	16		9			
IV	43	30	51		29			
V	8	54	10		60			
POG Harvest	0	1,106670	572,300		1,402,800			
C. Range Between Outcomes I + II and I + II + III								
Panel Year								
1997	>40, <71	>0, <8	>10, <55	>0, <8	>0, <4	>14, <48	>18, <55	>85, <98
1995	>33, <51	>5, <16	>23, <39		>3, <12			

[1] Mean likelihood outcome scores for the endemic mammal group by evaluators on the Other Terrestrial Mammals Assessment Panel in 1997 are shown in A. Scores from the 1995 panel also are shown in B. for alternatives common to both rating periods. Alternatives 1 and 9' are identical in features and acres of POG harvested. Alternatives 2 and 5 are identical in features but with fewer acres of POG harvested. A range for all alternatives is shown in C. for the likelihood of maintaining habitat to support viable and well distributed endemic mammal populations. Only 'after' scores are shown. The -414,000 value for POG harvest under Historic represents the acreage harvested since 1954.

B. Measures Added to Alternative 11 In Response to Panel Assessments

Results of risk assessment panels indicated moderate levels of concern for marten and small, endemic and widely-distributed mammals, a lower level of concern for goshawk, and a much lower concern for the wolf and brown bear. In response to these concerns for the mammal groups, marten and goshawk, and to further reduce risks to these species, protective measures were added to strengthen Alternative 11.

For endemic mammals, surveys will be conducted in project areas prior to management activities that would significantly alter habitat. Where distinct taxa are located, measures will be taken to provide for their continued persistence. Ongoing research into endemic mammals will be continued, and in some cases be accelerated, in order to refine the application of this "survey and manage" measure. This measure supplements previous steps taken to benefit endemic mammals, including the removal of islands of less than 1,000 acres from the timber base. A complete description of this measure is included in the Forest Plan, Chapter 4, Forest-wide Standards and Guidelines for Wildlife, XVII. Endemic Terrestrial Mammals.

A general landscape connectivity standard and guideline is designed to provide benefit for all taxa but particularly for the small mammals and other terrestrial vertebrates with limited dispersal capabilities. This measure will supplement existing provisions for connectivity through riparian and beach fringe buffers, and other land allocations that maintain the old-growth forest. Wherever those measures are inadequate to provide connectivity of old-growth forest between reserves, management will take additional steps to ensure that connectivity is maintained where it exists. A complete description of this measure is included in the Forest Plan, Chapter 4, Forest-wide Standards and Guidelines for Wildlife, XVIII. Landscape Connectivity.

Habitat management measures to further reduce risks to marten are directed at high value habitat in five biogeographic provinces where risks are judged to be higher due primarily to large amounts of young conifer forest (second growth) having little or no remaining forest structure important to martens. The overall objective is to avoid the creation of additional, significant gaps in marten habitat with resulting limitations on population interactions. In value comparison units (VCU's) where more than 33 percent of the original productive old growth has been converted to young forest, the objective is to avoid further significant fragmentation of high value marten habitat resulting from timber harvest. High value marten habitat is high volume strata productive old-growth forest below 1,500' elevation. This objective is met by restricting harvest units to less than 2 acres and using a 200-year rotation or, in larger units, maintaining significant canopy cover and coarse woody debris. In VCU's where productive old growth is less fragmented (i.e., less than 33 percent of the original productive old growth has been harvested), the objective of the mitigation is to retain structures that will allow harvested units to regain value as marten habitat in a relatively short time. This is accomplished by retaining coarse woody debris and green trees to act as a source of coarse woody debris during the next rotation. A complete description of this measure is included in the Forest Plan, Chapter 4, Forest-wide Standards and Guidelines for Wildlife, XVIII. Landscape Connectivity.

Additional habitat management measures for the northern goshawk are intended to provide benefit in areas on Prince of Wales Island where risks to goshawks are highest of all regions in southeast Alaska, and in VCU's where over 33 percent of the productive old growth has been converted to young forest. The objective is to maintain some canopy closure and large tree structure in harvest units to minimize further significant fragmentation of habitat in harvest units over two acres in size. A complete description of this measure is included in the Forest Plan, Chapter 4, Forest-wide Standards and Guidelines for Threatened, Endangered, and Sensitive Species, J. Northern Goshawk.

Details of these measures, the basis for their inclusion in Alternative 11, and their effects on species are described in the section below.

C. Effects of Added Habitat Management Measures

1. Other Terrestrial Mammals

a. Background

The other terrestrial mammals associated with productive old-growth have been broadly divided into two groups: widely-distributed species and endemic species. A total of 26 taxa within these 2 groups were explicitly considered by the panels asked to provide judgments for the other terrestrial mammals (Chapter 3). Two of these 26 taxa, northern flying squirrel and river otter, were the focus of specific measures in the original VPOP strategy. Small HCA's were adopted by the VPOP committee to provide for distribution of northern flying squirrels in every major watershed (i.e., every 10,000 acres). The size of these HCA's was intended to allow them to support 20 to 40 squirrels. VPOP also recommended that travel corridors be maintained between patches of flying squirrel habitat. They considered beach fringe and riparian zone to be suitable corridors, and recommended that additional corridors be designated in areas where these did not provide adequate connectivity.

The Prince of Wales river otter is strongly associated with saltwater beach fringe and freshwater riparian habitats (Larsen 1983, Noll 1988, Woolington 1984). VPOP's conservation recommendation for river otter was maintenance of beach fringe, estuary fringe, and riparian habitat associated with streams and lakes.

The review of Kiester and Eckhardt (1994) provided little comment on this aspect of the VPOP strategy. However, one of the common themes of many of the reviews was the lack of knowledge of all the taxa present on the Tongass and the distribution of species among islands. Kiester and Eckhardt (1994) recommended a thorough biological survey of the Tongass, and an evolutionary analysis of small mammals. Lidicker (in Kiester and Eckhardt 1994) recommended that no timber harvest take place on islands less than 1,000 acres or those that could be considered unique because of their isolation or known presence of endemics.

b. Panel Assessments

A discussion of the panel evaluations is contained in section III. A. of this appendix, and the planning record contains the full reports. In the 1995 evaluation, the VPOP strategy, most fully embodied in Alternative 3, was assessed as having the third highest likelihood, of those alternatives that propose continuing timber harvest, of maintaining both the widely-distributed and the endemic groups of mammals. In this assessment, substantial likelihoods of not maintaining species well-distributed were projected for all alternatives, including Alternative 1 which calls for no further timber harvest. These results were based, at least in part, on effects of past harvest, lack of knowledge of many of the mammal species, and risks inherent to endemic species. Alternative 11, as evaluated in the 1997 panel assessments, differed in several important ways from Alternative 3. It eliminated all islands less than 1,000 acres from the timber base as recommended by Lidicker (in Kiester and Eckhardt 1994). It extended the beach fringe to 1,000 feet, but also relied more heavily on short-rotation clearcutting than did Alternative 3. Of the alternatives evaluated in 1997 that propose continued timber harvest, it ranked second highest in likelihood of maintaining viable populations of the widely-distributed and endemic mammals. Despite its favorable ranking relative to the other alternatives, it still was projected to have substantial likelihood of not maintaining well-distributed populations. Alternative components that were viewed favorably by this panel included the presence of a reserve system, the amount of old-growth that would be retained in the matrix, and a process for site-specific analysis particularly related to endemic mammals.

c. Strengthening Alternative 11 to Reduce Risk

In response to the 1977 panel assessment, additional guidelines were added to Alternative 11 to increase the likelihood that viable populations of endemic mammals would be maintained. These guidelines require that surveys for endemic mammals be completed prior to projects that would substantially alter vegetation on islands of 50,000 acres or less. Surveys will also be conducted on larger islands if an initial assessment indicates high likelihood that endemic mammals are present on the site. Where endemic taxa are detected by the surveys, projects will be designed to provide for continued persistence of the taxa. As an additional measure, ongoing research of endemic taxa on the Tongass will be accelerated.

Other guidelines added to Alternative 11 in response to the panel assessments would also benefit both the endemic and widely-distributed mammals. The connectivity guideline will provide additional measures to maintain connectivity of large and small reserves and other non-development LUD's in places where beach fringe and riparian habitat management areas do not provide adequate connectivity. Guidelines for structural retention for goshawk and marten habitat will also benefit other mammal species.

d. Effects of Implementation

As noted in Chapter 3, the Prince of Wales flying squirrel may be of greatest viability concern among the endemic mammals that were specifically considered by the panels, and the northern flying squirrel may be of greatest concern among the widely-distributed mammals. According to Carey (1991), habitat factors important to northern flying squirrels include large, live trees; large snags; fallen trees; multilayered canopies; and connectedness of habitat either through large contiguous areas of habitat or through corridors of suitable habitat. Alternative 11 will provide these features through its system of large and medium HCA's interconnected with small reserves and matrix habitats. Each large HCA should have the capability to support 100 or more northern flying squirrels, medium HCA's to support more than 50 squirrels, and small HCA's to support 20 to 40 squirrels. These individual populations should have the capability to persist over short to intermediate periods of time. Interactions among these populations through the matrix would allow them to function as a metapopulation conferring high probability of long-term persistence. Dispersal through the matrix will be facilitated by the beach fringe and riparian habitat management areas, by the overall amount of old forest remaining in the matrix, and by additional measures prescribed under Alternative 11 to provide for connectivity. These additional measures could include relocating small reserves to better serve a role as connectors, thus providing for small squirrel populations at locations intermediate between the larger populations.

These same components of Alternative 11 will also reduce risks to the endemic species and the Prince of Wales flying squirrel. In addition, the 200,000 acre reserve designated on Prince of Wales Island will, by itself, support a moderately large population of squirrels. Another feature of Alternative 11 that will further reduce risk to Prince of Wales flying squirrels is the requirement to survey for endemic mammals on islands of 50,000 acres or less, or in other areas where there is a high likelihood of species presence. Application of this measure to Prince of Wales Island is likely to result in additional project-specific measures reducing risk to the squirrels. Finally, implementation of mitigation measures for goshawk and marten on Prince of Wales Island will result in the retention of structural features important to flying squirrels such as snags, logs, and large live trees.

Implementation of the survey requirement will substantially reduce risks to other endemic species. This requirement, in combination with the ongoing research on endemic taxa, is responsive to Kiester and Eckhardt's (1994) recommendation to conduct a biological survey on the Tongass.

2. American Marten

a. Background

American martens were one of the primary species considered in the design of the original VPOP strategy. By design, each large HCA was intended to support at least 25 female martens, medium HCA’s to support at least 5 female martens, and small HCA’s at least 1 female. Each large HCA was designed to support a population with high likelihood of at least short-term persistence. The design distance between large HCA’s was 25 miles, approximating the maximum dispersal distance recorded for marten, and medium and small HCA’s were spaced more closely. Forested corridors were to provide for dispersal among HCA’s. All corridors were to be at least 330 feet wide, and riparian and beach fringe habitats were considered appropriate corridors where they provided connections among the HCA’s. This network of interconnected HCA’s was intended to support a number of local populations that could interact as a metapopulation, thus providing for long-term viability.

Three of the scientists involved in the Kiester and Eckhardt (1994) review identified limitations in this strategy for marten. Benkman, Lidicker, and Powell questioned the use of the maximum marten dispersal distance to establish spacing among HCA’s. Benkman cautioned that this strategy would only work if the medium and small HCA’s provided connections among the large HCA’s. Lidicker added that the condition of the matrix ought to be considered when establishing distances among HCA’s. Powell indicated that marten would generally not travel directly between HCA’s, so the actual distances they would have to cover would exceed the design distance. None of these reviewers commented directly on the size of large or medium HCA’s, but both Benkman and Powell noted that the small HCA’s would be unlikely to support even one pair of marten. A number of the reviewers in Kiester and Eckhardt (1994) commented in general that the utility of corridors for wildlife dispersal had not been demonstrated. None of these comments were specific to marten, possibly because marten are known to make extensive use of riparian zones (Bissonette et al. 1989; Clark et al. 1987).

b. Panel Assessments

The VPOP strategy is most fully represented in Alternative 3. The risk assessment panel convened in 1995 rated this alternative intermediate between Alternative 1 (no further harvest) and Alternative 9 (continuation of the existing plan). They indicated that there was a better than equal likelihood that implementation of this alternative for 100 years would result in significant gaps in marten habitat distribution on the Tongass. They projected no likelihood that marten would be extirpated from the entire forest under this alternative.

The risk assessment panel convened in 1997 gave Alternative 11 a similar risk rating to that given to Alternative 3 in 1995. Alternative 11, as rated by the panel, provides for a wider beach fringe buffer than Alternative 3, but it also relies more heavily on even-aged management in the matrix. Panelists noted that the projected matrix conditions had a significant influence on their ratings. The panelists convened in 1997 also clarified their interpretation of the outcomes that were used as the basis for risk assessment. Outcome III, defined as providing habitat to maintain breeding populations but with significant gaps in historic distribution, was interpreted as an array of conditions. At one end of this array was any condition where gaps in habitat existed as small as the territory of a single marten. At the other end this array could include conditions with broad gaps in habitat distribution and significant limitations on population interactions. The panelists considered some part of this array of conditions as meeting the definition of viable and well-distributed. The panelists assigned a total of 91 likelihood outcome points to the sum of Outcomes 1 + II + III. This included 38 likelihood points in Outcomes I and II, which they considered to represent a viable and well distributed condition. It also includes 55 likelihood points in Outcome III, some portion of which represents a viable and well distributed condition. The panelists indicated there was a very low likelihood that marten would exist only in refugia or be extirpated from the Tongass after 100 years of Forest Plan implementation with a combined Outcome IV and V score of 9. The panelists indicated that matrix management was the feature of Alternative 11, as rated, that contributed to the assignment of likelihood points to outcomes that were not well-distributed. They indicated that clearcut silviculture on a 100-year rotation would result in further fragmentation of marten habitat.

c. Strengthening of Alternative 11 To Reduce Risk

Alternative 11 was strengthened subsequent to the panel assessment because that assessment indicated a level of concern about the likelihood of marten populations remaining well-distributed across the Tongass for at least 100 years. The measures used to strengthen the alternative were based on comments provided by the panelists, information drawn from past studies on marten, and information on existing habitat conditions on the Tongass. Three different measures were applied to Alternative 11 to improve the likelihood of maintaining habitat to support well-distributed populations of marten.

The first directs the management of high quality marten habitat in five biogeographic provinces where marten habitat is currently considered to be at higher risk. These five biogeographic provinces were identified by the VPOP risk assessment as the highest risk provinces of the 21 provinces across the Tongass National Forest (Suring et al. 1993). High value habitat is defined in the Interagency Marten Habitat Capability Model (Suring et al. 1993) as consisting of high volume old-growth stands at elevations below 1500 feet. Within the high risk provinces, these stands will be managed under practices other than clearcutting. In VCU's where 33 percent or more of the productive old-growth has been or is projected to be harvested, further harvest in any high value marten habitat will retain at least 30 percent canopy closure, 8 large live trees per acre, 3 large decadent trees per acre and 3 logs per acre. Where less than 33 percent of productive old-growth has been harvested, further harvest in high value marten habitat will retain 10-20 percent canopy closure, 4 large live trees per acre, 3 large decadent trees per acre, and 3 logs per acre. These habitat management measures were based on studies showing marten use higher in partially logged areas than clearcut areas (Soutiere 1979); a recent study by Hargis and Bissonette (in press) indicating that the proportion of clearcut harvesting at a landscape scale is a key determinant of marten success; and numerous studies showing the importance of large wood structure to marten (Baker 1992, Buskirk et al. 1989, Corn and Raphael 1992, Raphael and Jones (in press)).

The second measure provides for access management to reduce marten mortality in areas where mortality rates due to trapping/hunting have been identified as a serious risk to marten populations. The third measure provides additional assurance of maintaining connections between habitat blocks throughout the Tongass. It requires an analysis of the effectiveness of features such as small reserves, beach fringe and riparian buffers in providing for connection between old-growth blocks in medium and large reserves and other natural setting LUD's. Where these measures do not provide for full connectivity, additional habitat will be allocated to provide for connectivity of old-growth habitats.

d. Effects of Implementation

With all measures in place, Alternative 11 will provide for a network of large and medium-sized HCA's, capable, respectively, of supporting 25 and 5 female marten each. Connection between HCA's will be provided by protected habitats in riparian and beach fringes, small HCA's, and additional old-growth habitat designated for connectivity where these protected habitats are not adequate. Connections through the riparian and beach fringe are likely to be effective for marten based on studies that have shown preferential use by marten of riparian zones (Buskirk et al. 1989, Raphael and Jones (in press), Spencer and Zielinski

1983). The matrix between the reserves will also contain significant, although fragmented, old-growth habitat. An average of 57 percent of the pre-1954 productive old growth will remain unharvested in the matrix areas through the planning horizon of 100 years. The percent of old growth remaining in the matrix will vary by province, but in those provinces considered at highest risk the additional habitat measures described above will be applied in the matrix. In addition to all of the above habitat measures, road access will be managed to reduce marten mortality where mortality has been identified as a significant risk.

Full implementation of the above strategy should increase the likelihood of maintaining habitat that will support well-distributed marten populations. While there will likely be gaps in this distribution, there is low likelihood that there will be significant isolation among marten populations resulting from implementation of Alternative 11.

3. Northern Goshawk

a. Background

Section IV. C. of this appendix presents a detailed analysis of the effects of the proposed plan on northern goshawks, so only a brief summary on goshawks is presented here. The 1997 panel ratings of Alternative 11 for goshawk assigned 71 likelihood points to the sum of Outcomes I and II, and 97 likelihood points to the sum of Outcomes I, II and III. This rating was second highest of all alternatives that proposed to continue timber harvest, only slightly lower than the rating given to Alternative 5. Conversely, Alternative 11 was rated as having very low likelihood of goshawks existing in refugia or being extirpated from the Tongass after 100 years of Forest Plan implementation with a combined Outcome IV and V score of 3. However, because the goshawk has been considered for listing under the Endangered Species Act, Alternative 11 was reviewed to determine if features of the alternative could be modified to improve the projected outcome.

b. Strengthening of Alternative 11 To Reduce Risk

The conservation assessment for northern goshawk (Iverson et al. 1996) evaluated the effect of various management practices on goshawk nesting and foraging habitat, and also identified specific geographic locations where goshawk habitat has been highly fragmented. Based on this information, an additional measure for goshawk habitat was prescribed for Prince of Wales Island where productive old-growth has been fragmented by past management actions. This measure applies in VCU's where over 33 percent of productive old-growth has been converted to young stands by past management. In those VCU's, any additional management of productive old-growth will either be restricted to two-acre clearcuts or be managed to leave significant structure in harvested stands.

c. Effects of Implementation

This standard and guideline will apply to management activities in 28 VCU's on Prince of Wales Island. Approximately 55 percent of the total original productive old-growth has been converted to young forest in these VCU's. For any additional harvest of productive old-growth in these VCU's, the standard and guideline will have the effect of either implementing a 200-year uneven-aged management regime or leaving structure equivalent to 30 percent of the cover of the original stand. Neither of these practices is expected to produce high value nesting habitat, but they will result in moderate to high value foraging habitat (Iverson et al. 1996). This structure, in combination with matrix management provisions for beach fringe and riparian management areas, will facilitate goshawk dispersal among large and medium reserves on Prince of Wales island. Goshawk will also be benefited in other provinces by the measures put in place for marten and for connectivity. Again, these will have the effect of facilitating dispersal among goshawk populations in reserves. Taken in combination with other measures already in place in Alternative 11, these will increase the already high likelihood of providing habitat sufficient to maintain viable and well-distributed goshawk populations.

4. Effects of Additional Measures on Timber Availability

The potential effects of these additional standards and guidelines on the calculated allowable sale quantity (ASQ) have been considered. Overall, the net effect of the additional habitat management measures discussed in this appendix are expected to be sufficiently small that recalculation of the ASQ for Alternative 11 as presented in the FEIS is not necessary.

The habitat management measure for connectivity is projected to have very little if any effect on timber availability. An analysis was conducted at the regional scale and identified possibly three areas where connectivity limitations may be encountered. Even if local analysis identifies more areas where application of this connectivity measure is needed, the total number of areas will be small and the effect on timber availability negligible. Furthermore, the Old-growth Habitat LUD provides for the reexamination of the current placement of small old growth habitat reserves that are designed, in part, to maintain landscape connectivity. Where connectivity may be insufficient, small reserves may be adjusted to provide needed connectivity, with little or no net change in timber availability anticipated.

The survey and management measure for endemic mammals requires surveys prior to timber harvest on smaller islands and where appropriate on larger islands. Based upon results of these surveys, some harvest plans may have to be altered. However, the acreage of programmed timber harvest is expected to be small. The effect of this measure is expected to be small relative to the total ASQ for the Tongass.

Habitat management measures for the goshawk and marten will limit the use of clearcutting and require the use of alternative silvicultural techniques on a portion of the suitable timber land base, primarily on northern and central Prince of Wales Island and in certain other biogeographic provinces. Where applied and found necessary, the effect will be to approximately double the rotation age, and reduce the volume available for harvest in any time period by about half. Moreover, some of the alternative silvicultural techniques required in the marten and goshawk standards and guidelines have already been accounted for in ASQ calculations; these habitat management measures simply serve as additional guidance where such techniques may be necessary to address risk to marten and goshawks. Overall, the net reduction in available timber is expected to be small relative to the total ASQ for the Tongass.

IV. Forest Plan Old-Growth Habitat Strategy and Additional Analysis for Species of Special Management Concern

A. Old-Growth Forest Habitat Strategy

1. Overview

An integrated old-growth forest habitat conservation strategy has been developed as part of the revised Forest Plan. The old-growth strategy has two basic components. The first is a forest-wide reserve network that protects the integrity of the old-growth forest. The old-growth reserves include a system of large, medium, and small Habitat Conservation Areas allocated to the Old-growth Habitat Land Use Designation (LUD), and full protection of all islands less than 1,000 acres in size. The reserve network also includes all other non-development LUD’s. These include Wilderness, Legislated LUD II, Wild River, Remote and Semi-remote Recreation, Research Natural Area, Municipal Watershed, and all other LUD’s that essentially maintain the integrity of the old-growth ecosystem. The second component of the old growth habitat conservation strategy is management of the matrix, e.g., the lands with LUD allocations where commercial timber harvest may occur. Within the matrix, components of the old-growth ecosystem are maintained by standards and guidelines to protect important areas and provide old-growth forest habitat connectivity. The following analysis describes the rationale for the strategy and its specific components.

Development of the old-growth strategy has relied on several key scientific documents that provided the basic foundation for addressing wildlife viability. These include the Interagency Viable Population Committee (VPOP) Conservation Strategy (Suring et al. 1993), the PNW Peer Review of the VPOP Strategy (Kiester and Echkardt 1994) and the VPOP Response to the PNW Peer Review (Suring et al.

1994). In addition, the Alexander Archipelago Wolf (Person et al. 1996) and Northern Goshawk (Iverson, et al. 1996) conservation assessments provided the basis for design of some components of the strategy as well as a basis for examining whether the old-growth strategy would sustain viable and well distributed populations of these two species. A detailed analysis is presented for each of these species in Sections IV. B. and IV. C. Section A provides a discussion of the major features, findings, and recommendations of each of the three conservation planning (VPOP related) documents, a consideration of features and recommendations in each document, and the integration of features in the deliberative process to arrive at an overall strategy to address viability of old-growth associated species. A description of the resulting old-growth strategy is provided, followed by a quantitative analysis of features of the strategy

The appendices referenced throughout this section are listed at the end of the document.

2. VPOP Strategy

There is a substantial science base for an old-growth habitat reserve approach for addressing wildlife viability (See FEIS Chapter 2 - Wildlife Viability and Chapter 3 - Biodiversity and Wildlife). The Interagency Viable Population Committee (VPOP) (Suring et al. 1993) performed pioneering work in designing a landscape conservation strategy to address wildlife viability. VPOP was commissioned by the Tongass Land Management Plan (TLMP) Revision Team to provide recommendations for sustaining habitat to help ensure the maintenance of well-distributed viable populations of all old-growth associated wildlife species across the Tongass. VPOP systematically screened all wildlife species and identified those old-growth associated species they considered to be most sensitive to habitat loss and fragmentation of the old-growth ecosystem. Their 'coarse filter' landscape strategy designed to consider the entire complement of old-growth associated species, included a system of large (40,000-acre) and medium (10,000-acre) Habitat Conservation Areas (HCA's) with spacing and habitat composition requirements well distributed across the Tongass. Small (1,600-acre) HCA's in each major watershed (> 10,000 acres) and individual species-specific management guidelines also were recommended.

Landscape connectivity was an integral feature of the original VPOP landscape conservation strategy (Suring et al. 1993). VPOP reviewed the available literature and concluded that there was limited empirical support for corridors but that this should not preclude their inclusion in landscape conservation planning. They reasoned that landscape habitat connectivity was an important component of conservation planning to facilitate animal dispersal and movement, whether specifically designed as corridors or through overall management of a habitat matrix. They recommended (p. 30) a 500-foot beach fringe buffer forest-wide and 200-foot buffers on anadromous fish streams. Breaks in these buffer corridors should be less than 65 feet to facilitate flying squirrel dispersal.

VPOP mapped the large and medium reserves and provided guidance for locating the small reserves, stating that their mapping effort represented only one possible application of the old-growth reserve system across the forest. VPOP concluded that their strategy represented "the minimum amount and distribution of habitat necessary to assure a high likelihood of maintaining viable, well-distributed populations of old-growth associated wildlife species across the Tongass National Forest" (p. 37). Their strategy and extensive supporting analysis are contained in *A Proposed Strategy for Maintaining Well-Distributed, Viable Populations of Wildlife Associated With Old-Growth Forests in Southeast Alaska*.

3. PNW Review

The Forest Service Pacific Northwest Research Station was requested by the Alaska Region to conduct an independent scientific peer review of the VPOP strategy. Kiester and Eckhardt (1994) obtained technical reviews from 18 scientists from North America with substantial knowledge and experience in species ecology or conservation biology. Kiester and Eckhardt (1994) synthesized these technical reviews and published all reports in the document *Review of Wildlife Management and Conservation Biology on the Tongass National Forest: A Synthesis with Recommendations* (PNW Review).

The general concepts in VPOP's multiscale habitat conservation strategy received positive support from the scientists involved in the PNW Review: Beckman (p. 37): "The proposal of HCA's of three sizes somewhat uniformly scattered across the landscape seems like a reasonable strategy...”; Forsman (p. 48): “...proposed network of conservation areas is a reasonable start in combination with protection of known (goshawk) nest areas within the matrix.”; Hansen (p. 50): “The core approach of this report (strategy) is scientifically sound and generally consistent with modern conservation biology.”; Jarvis (p. 71): “The strategy is an innovative and bold attempt to apply species, community, and ecosystem concepts to applied management.”; Lande (p. 78): “...a good initial attempt to develop a strategy for maintaining biodiversity.”; Lidicker (p. 87): “The strategy outlined is a giant step in the right direction, but improvements are needed...”; Marcot (p. 101): “...the process and basis for the proposed conservation strategy is scientifically sound given our current knowledge base...”; and Walters (p.194): “...the overall management strategy that considers landscape level features is excellent. The approach is well-grounded in the best current information in conservation biology...”. Kiester and Eckhardt (p. 5) concluded in their summary review that “the Strategy (VPOP) receives high marks. It represents a solid attempt to integrate species viability concerns with the Habitat Conservation Area approach.”

The PNW Review identified several weaknesses in the VPOP strategy. For example, corridors were considered inadequate, there was insufficient attention directed to the matrix lands, and Habitat Conservation Areas’ (HCA’s) were considered to be too small by many scientists. Kiester and Eckhardt (1994 p. 5) concluded that “the particular pattern of Habitat Conservation Areas that it [the VPOP strategy] suggests will not ensure viability of all species”--although no individual species were specifically identified. Careful examination of all reports by the 18 scientists that participated in the PNW Review revealed repeated concerns relative to brown bears and wolves (Lande p. 82; Lidicker p. 91; McLellan p. 132, Paquet p. 143; Pletscher p. 147; Powell p. 156, and in the summary by Kiester and Eckhardt, p. 16, 17)) and that 40,000-acre large HCA’s recommended by VPOP were too small to sustain populations of these wide-ranging species. Lande recommended that at least one very large HCA be maintained in each ecological province or island (p.81); Lidicker recommended a “few large areas, one per island or island group” (p. 91); McCullough (p. 116) recommended fewer but larger HCA’s to support continuous populations; and Pletscher (p. 147) suggested an “inverse HCA” concept of very large preserved landscapes with small areas allocated for timber harvest.

Importantly, Kiester and Eckhardt (1994, p.3) noted that the PNW Review only considered the network of mapped VPOP large and medium HCA’s and Congressionally protected areas such as Wilderness, Monuments and Legislated LUD II areas. The VPOP reserve network was not examined in the context of the entire forest plan or a fully articulated planning alternative containing the strategy. The scientists were unable to consider other Land Use Designations (LUD’s) that effectively function as reserves and conserve the old-growth ecosystem—a very important component incorporated into the development of the old-growth habitat conservation strategy in the revised Forest Plan and this analysis.

Corridors and landscape connectivity received considerable attention among the scientists involved in the PNW Review, and somewhat differing opinions emerged regarding how to address landscape connectivity. Lidicker recommended 1,000-foot corridors (p. 91), while Lande (p. 82) recommended corridors of up to 4,000 feet wide. Other scientists questioned the value of explicitly designed corridors. McCullough (p. 116) noted that “corridors are of considerable debate” and recommended larger reserves to minimize reliance on dispersal corridors; Paquet (p. 137) stated “there are few controlled data with which to assess the conservation role of corridors, thus it is difficult to support or refute their value” but added “..maintenance or restoration of connectivity in the landscape is a prudent strategy”; Pletscher (p 147) stated “There are few empirical studies documenting the value of narrow corridors” and recommended more attention be focused on overall management of the matrix; and Powell (p. 154) agreed with VPOP regarding uncertainty of corridors and recommended more attention be given to the intervening landscape matrix to facilitate wildlife movement and dispersal. Kiester and Eckhardt (p. 17) stated that overall landscape connectivity was an essential component of an old growth conservation strategy and wider corridors were necessary (especially for marten), particularly relative to ecological pinch points, but cautioned that corridors are “virtually untested in practice.”

In their summary chapter, Kiester and Eckhardt (1994) provided many recommendations that specifically relate to forest planning and features of landscape design:

- The existing largest blocks of contiguous high volume old-growth forest should not be further fragmented by timber harvesting or road building.
- Incorporate larger reserves.
- Incorporate wider corridors.
- Do not differentially cut low altitude, high volume old-growth
- Consider an inverse habitat conservation area concept.

They provided many other sound management recommendations not directly related to landscape planning design, such as adaptive management, biological inventory, gap analysis, and population viability analyses.

4. VPOP Response

Suring et al. (1994) specifically responded to individual recommendations made in the Kiester and Eckhardt (1994) review of the VPOP Conservation Strategy in the document: *Response to the Peer Review of: A Proposed Strategy for Maintaining Well-distributed, Viable Populations of Wildlife Associated with Old-Growth Forests in Southeast Alaska* (VPOP Response). In this brief (11 pages with appendices) response, Suring et al. (1994) indicated that the document represented an "initial response" outlining additional elements that would be considered in their preparation of a final Conservation Strategy as provided for in the peer review process, stating "additional support will be needed by the Committee (VPOP) from the Forest Service to adequately incorporate the recommendations of the peer reviewers into our manuscript and to publish that manuscript" (Suring et al. 1994, p. 3).

Within the VPOP Response, seven specific recommendations were made that were responsive to PNW Review comments. All recommendations were considered during the Viability Synthesis Workshop (Iverson and Rene, 1997) to identify building block concepts for forest plan alternative development. All VPOP Response recommendations were analyzed spatially and quantitatively (Iverson 1996a). In doing so, the Forest Plan interdisciplinary team (IDT) concluded that the features described in the recommendations would not collectively represent a fundamentally different alternative than existed within the range for forest plan alternatives considered in the Revision planning process and that general concepts recommended (e.g., larger reserves and wider corridors) were already addressed.

Specifically, from the PNW Review recommendation to "keep landscape options open, and do not further fragment existing large blocks of high volume old-growth," the VPOP Response generated the following recommendation: "it is important that the largest remaining patches not be fragmented. This may (emphasis added) be accomplished by restricting logging and road building to areas other than the 3 largest old-growth forest patches within each ecological province" (p.8). The PNW Review referred to blocks of old growth while the VPOP response referenced "patches"; the PNW Review recommendation specifically mentioned "high volume" old growth—VPOP did not; the VPOP Response only recommended that the three largest old-growth forest patches be protected—the PNW Review suggested all blocks. Despite slight but important differences between these two recommendations, we concluded that minimizing additional fragmentation of large areas of old-growth forest with a focus on the high volume class strata was the basic intent of the recommendations.

Noting the limitations in their original conservation strategy identified by the PNW Review, the VPOP Response considered the diversity of opinion among the scientists concerning corridors and provided a series of explicit corridor recommendations. They recommended that a beach fringe corridor of 3,300 feet be established forest-wide within which only selective uneven-aged management could be applied. They also recommended that 1,000-foot and 1,600-foot no harvest corridors be designated to connect medium and large HCA's, respectively. These corridors should be located below 800 feet in elevation.

5. Old-Growth Forest Habitat Conservation Strategy

The TLMP IDT carefully reviewed the landscape design recommendations contained in the documents discussed above. In consideration of all multiple-use issues and concerns, they designed a habitat strategy that is responsive to the recommendations discussed above. This strategy represents the integration of many elements, some of which are specific to addressing wildlife viability (see below), others of which respond to other issues, such as Congressional legislation (Wilderness, National Monument, and Legislated LUD II), riparian habitat management from the Anadromous Fish Habitat Assessment, or the allocation of lands to Remote and Semi-remote Recreation in recognition of recreation and tourism uses.

After considering the PNW Review by prominent scientists and considering all other available information, the IDT incorporated the VPOP HCA strategy as the cornerstone of the old-growth forest habitat strategy in the revised Forest Plan. This represents a fundamental 'coarse filter' approach to addressing wildlife viability and the conservation of biodiversity (See FEIS - Biodiversity and Wildlife Sections for a discussion of the 'coarse' and 'fine' conservation approaches). Species specific standards recommended by VPOP (e.g. brown bear, goshawk, wolf, great blue heron, etc.) have been fully considered in light of additional information such as conservation assessments, panel assessment results, etc. and appropriate standards and guidelines have been incorporated into the Threatened, Endangered, and Sensitive Species and Wildlife sections of the Forest Plan.

a. Habitat Reserves

The mapped system of 149 large and medium HCA's originally designed by VPOP as "one possible application of the proposed strategy" was integrated into Forest Plan through allocation to the Old Growth Land Use Designation (LUD). Spatial modifications to the original VPOP large and medium HCA's have been made for the revised Forest Plan. This is provided for in the VPOP report as long as HCA design criteria for size, spacing, and composition are maintained (Suring et al. 1993, p. 30). In their HCA composition analysis, Suring et al (1993) also identified limitations in their mapped strategy. Subsequent modifications have been made to large and medium HCA's to correct limitations. Modifications have been made for several reasons:

- the original VPOP delineation did not meet minimum HCA criteria (e.g., St. James Bay Large HCA);
- the original delineation incorporated large amounts of fragmented clearcut landscape (e.g., Couverden and Kelp Bay Large HCA's);
- the original VPOP delineation exceeded minimum criteria (Ratz Harbor, Aaron's Creek medium HCA's);
- the integrity of the original HCA was substantially compromised by recent timber harvest that was inconsistent with HCA objectives (Game Creek Large HCA);
- reserve location was adjusted to achieve multiple use objectives such as timber harvest.

Even after these modifications, large and medium HCA's may still not precisely match the specific VPOP size, spacing and habitat composition design criteria. A detailed analysis has been conducted of how well the original mapped VPOP reserves and the design criteria are integrated into the Forest Plan (Iverson 1997). Considering the spacing criteria, VPOP found that over 90 percent of the 149 HCA's they mapped forest-wide met the minimum spacing criteria, and those that did not were generally isolated islands or within Wilderness (Suring et al. 1993, Table 8, 9). Very few HCA's have been completely moved (Iverson, 1997), thus the current location of mapped reserves is considered in general compliance with the original VPOP design. While site-specific compliance is not always perfect, either exceeding or occasionally deficient in VPOP design criteria, fine-tuning application of the strategy would take many iterations. As VPOP concluded, "a 'perfect' application of this conservation strategy does not exist" (Suring et al. 1993, p. 35). Furthermore, standards and guidelines in the Old Growth LUD provide for the examination of the size, spacing, and composition criteria for each reserve at the project level and provides for necessary adjustments to ensure minimum design criteria are met.

Small (1,600-acre) HCA's in each 10,000-acre watershed were recommended by VPOP, to be mapped during project implementation. VPOP identified two objectives for small HCA's (Suring et al. 1993, p. 28): "to provide temporary functional habitat for animals dispersing between large and medium HCA's and to ensure that species of concern have a relatively high likelihood of occurring in each 10,000+ acre watershed." The IDT identified and explicitly mapped the small reserves in the Forest Plan as part of the Old-growth LUD. These small reserves also contribute to the overall landscape matrix outside large and medium HCA's (see b. Matrix Management). Approximately 237 small reserves were mapped. These included nearly 267,000 acres of productive old-growth forest within a total of 480,000 acres (Appendix 1). These reserves represent an important component of the forest-wide old-growth habitat conservation strategy.

The need for larger habitat reserves (larger than provided by VPOP) and minimizing fragmentation, in general, and specifically for brown bears and wolves, was a consistent recommendation expressed by the PNW Review scientists. The Forest Plan, in response to observations of the PNW Review scientists and management considerations contained in the interagency wolf conservation assessment (see Alexander Archipelago Wolf below), contains at least one very large reserve within each of the 21 biogeographic provinces across the Tongass to address large scale distribution of large old growth reserves (Appendix 5). This action is specifically responsive to Lande's recommendation (p. 81, in Kiester and Eckhardt 1994) of one large reserve per province and to other scientist's concerns that VPOP's HCA's were too small. A quantitative definition of large was not provided in any reference, however, multiples in excess of the VPOP large HCA's of 40,000-acres may be considered as 'large' (1-2 times as large) or 'very large' (3 or more times as large).

The VPOP Response also recommended the following: "it **may** (emphasis added) also be necessary to establish 0.5- to 1-mile buffers around all Large and Medium HCA's as a "special management zone" permitting removal of up to 25 percent of the standing volume in 5-acre units using uneven-aged timber management. This recommendation relates to the need for larger old-growth forest reserves. This feature has been incorporated into the Forest Plan in a different way than proposed in the VPOP Response. As discussed above, at least one very large reserve per province has been allocated. Furthermore, the VPOP Response recommendation would have permitted substantial harvest (up to 25 percent) of the expanded area. The Forest Plan protects entire reserves without selective harvest and associated additional reduction of old-growth forest.

Both the PNW Review and VPOP Response expressed concern for disproportionate harvest of higher volume old growth stands. VPOP Response specifically recommended (p. 9) that "it is necessary to defer logging and road building in volume class 6 and 7 old-growth forest (as determined by field reconnaissance) below 800 ft. elevation until a biological survey is completed." The IDT recognized the concern for higher volume stands and has taken a broader approach toward protecting larger reserves and intact landscapes, which necessarily include higher volume stands (See d. Identifying and Mapping Old-Growth Reserves) The IDT did not believe that a focus on protecting small isolated stands of the former volume class 6 and 7 that may be imbedded within a mosaic of clearcuts, susceptible to windthrow, was a prudent management approach to addressing conservation of old-growth associated species.

The final fine-scale component of the reserve strategy addresses potentially endemic taxa (species or sub-species) that may exist on small islands. MacDonald and Cook (1994) reported 27 mammal taxa endemic to Southeast Alaska. Many may have limited dispersal capabilities and are restricted to individual islands (e.g., Coronation Island vole); some may also be susceptible to loss and fragmentation of old-growth habitat. Populations existing on small islands (oceanic or habitat fragments) are more susceptible to local extinction (Wilcove et al. 1986, Burkey 1995). The archipelago of Southeast Alaska contains over 22,000 islands (Iverson 1996b) and uncertain but likely high levels of biotic endemism (MacDonald and Cook 1994). Lidicker (in Kiester and Eckhardt, 1994, p. 91) identified a concern for small island endemic taxa and recommended that no logging occur on islands of less than 1,000 acres to reduce risks to these taxa, and further recommended that at least one reserve be maintained on larger islands. The Other Mammal Assessment Panel expressed similar concerns relative to endemic taxa (Julin, 1996).

In response to these concerns about endemic taxa with possibly unique gene pools that may be restricted to small islands, the Forest Plan protects all islands less than 1,000 acres from additional harvest of old-growth forest, in direct response to the Lidicker recommendation and concern expressed by the Other Mammal Assessment Panel.

b. Matrix Management

The second component of the old-growth forest habitat conservation strategy is management of the area outside reserves (the “matrix”) that is subject to timber harvest. This topic was of notable concern to the PNW Review scientists who suggested that more attention be directed to this component of landscape conservation planning. They particularly noted the need to provide enhanced landscape connectivity and to manage human disturbance of the land similar to natural disturbance regimes (Kiester and Eckhardt 1994: Hansen p. 52; Lande p. 82; Lidicker p. 87; McCullough p. 109; McClellan p. 133).

Some management protections within the matrix are spatially explicit, such as the 1,000-foot beach and estuary fringe, and the riparian buffers for maintaining the integrity of the aquatic and riparian ecosystems. Other forest-wide standards and guidelines preclude or significantly limit timber harvest in areas of high hazard soils, steep slopes, karst terrain, visually sensitive travel routes and use areas, and in timber stands technically not feasible to harvest.

Beach and estuary fringe, and riparian habitats, have special importance as components of old-growth forests, serving as wildlife travel corridors, providing unique wildlife habitats, and providing a forest interface with marine or riverine influences that may distinguish them as separate ecosystems within the larger old-growth forest ecosystem. Riparian areas are important for fisheries in providing, among other resources, the source of large woody debris that creates pools for rearing habitat, and in controlling stream temperatures and the amount of sediment reaching streams. Riparian areas provide habitat for terrestrial species associated with aquatic environments (amphibians, for instance, or mammals such as river otter and beaver), and for terrestrial species for which fish from streams are important food (brown and black bears). Considering the dendritic nature of riparian systems that begin high in watersheds, these riparian areas provide forested corridors connecting higher elevation regions in upper watersheds with lower elevation forests in valley bottoms. Riparian areas often contain plant species which can live only where water is available year-round. Riparian soils often support large spruce trees and some of the most highly-productive stands of old growth.

The beach fringe, the forested area adjacent to salt-water shorelines, is thought to be an important wildlife travel corridor, a transition zone between interior forest and salt water influences, and a unique habitat (or micro-climate) in itself. The beach fringe is a very important feature on the Tongass given the extensive amount of shoreline (more than 13,000 miles) that exists on the more than 22,000 islands. The beach fringe provides horizontal or low-elevation connectivity between watersheds, many of which otherwise have very steep sides and/or non-forested ridgetops. In conjunction with riparian areas, which provide connectivity within watersheds, the beach fringe is thought to be a component of the major travel corridor system used by many resident wildlife species.

Interagency habitat capability models developed for management indicator species of the Tongass indicate that the highest habitat suitability value was assigned to productive old-growth forests within the 500-foot beach fringe zone for the bald eagle, marten, and river otter (Suring 1993). The beach fringe was rated second only to the 1,000-foot estuary fringe for brown and black bears in overall habitat quality, and higher deer habitat values generally occur in high-volume old-growth below 800-foot elevation, much of which occurs in the beach zone with a moderating maritime-influenced microclimate. A revised marten habitat capability model rated the beach fringe old-growth forests highest among all habitat components (Flynn, 1995).

There are indications that the value of the beach zone habitat may extend beyond 500 feet. Gende et al. (in press) reported reduced bald eagle nesting densities and success in landscapes adjacent to clearcuts and recommended a beach buffer zone of at least 1,000 feet. The 1,000-foot beach fringe also is used frequently by radio-marked goshawks (Iverson et al. 1996). The importance of the beach fringe zone has long been recognized, and was a component of the Retention Factor Method used in the 1979 Tongass Plan, as amended (USDA Forest Service, 1986) (specifically recognizing the importance of the 1,000-foot beach fringe for brown/black bear, 600-foot for furbearers, and ¼-mile inland from the beach for deer winter range).

In developing the old-growth forest habitat strategy, the information described above and the available literature relative to Southeast Alaska were carefully examined. The IDT concluded that explicit corridors should be a component of a landscape conservation strategy, that a 1,000-foot beach and estuary fringe corridor was clearly justified by the available information but that no evidence supported a 3,300-foot buffer recommended by the VPOP Response. The IDT further reasoned that a 1,000-foot no harvest beach and estuary fringe corridor was comparable or possibly superior to a 3,300-foot corridor that permitted up to 25 percent of the volume removed in 5-acre patch cuts as recommended by the VPOP Response. Accordingly, the Forest Plan establishes a Beach and Estuary Fringe Forest-wide Standard and Guideline that prevents timber harvest within 1,000 feet inland from mean high tide. The 1,000-foot beach fringe serves many functions: providing more effective landscape linkages between habitat reserves, protecting long-term bald eagle habitat capability, buffering the primary beach fringe zone (0 -- 500 feet) from windthrow (Hodges 1982, Harris 1989), maintaining a functional interior forest condition within the entire primary beach fringe (Concannon 1995), and sustaining very important habitat for goshawks (Iverson et al. 1996).

In addition, the Forest Plan incorporated, as a minimum, the riparian habitat recommendations in the Anadromous Habitat Fish Assessment (AFHA 1995). Riparian habitat buffers also provide elevational corridors within forested watersheds. Mapping the small old growth habitat reserves (see above) also provides additional landscape connectivity. Together, the beach and riparian habitat management features and the mapping of small reserves represent a substantial response to the landscape linkage element of conservation planning and significantly contribute to management of the overall matrix among habitat reserves.). Finally, the Forest Plan contains a standard and guideline that provides for the maintenance of a contiguous forested corridor, where it exists, connecting each large or medium habitat reserve to at least one other reserve.

Stand level habitat management objectives, that will also contribute to maintaining features of old growth forest within the matrix, have been established in the Forest Plan to reduce the adverse effects of clearcut timber harvest to marten and goshawk habitat use by retaining important forest structure during harvest. These habitat management measures have been added to the Forest Plan in response to panel assessments (see Section III.B. In the North and Central Prince of Wales Biogeographic province, where current risks to sustaining goshawks was greatest (Iverson et al. 1996), standards and guidelines provide for the retention of forest structure during harvest in VCU's where over 33 percent of the original productive old growth has been harvested and harvest units are over two acres. This management standard and guidelines maintains an average of at least 30 percent canopy closure after harvest and requires that an average of at least 8 large (20-30" DBH) trees/acre are retained at harvest. The objective of this provision is to retain some foraging habitat value during harvest; silvicultural prescriptions that retain this amount of material are superior to clearcut harvest (Iverson et al. 1996).

Similar stand level structural retention standards and guidelines in the Forest Plan have been established to manage high value marten habitat. These standards and guidelines apply to the five higher risk biogeographic provinces identified by VPOP (Suring et al. 1993, p. 41) (East Chichagof, Kupreanof/Mitkof, Etolin Island and Vicinity (except Zarembo), Revilladagado Island and Vicinity, and North and Central Prince of Wales Island). In VCU's within these provinces where over 33 percent of the original productive old growth has been harvested, including additional future harvest, high value marten habitat will be managed to retain important forest structure for marten. Harvest units over two acres in size in high value marten habitat (e.g. high volume timber strata and below 1500' in elevation) will retain after harvest: an average of over 30 percent canopy closure, an average of at least 8 large trees/acre (20-30" DBH), an average of at least 3 large decadent (20-30" DBH dead or dying trees) trees/acre, and an average of at least 3 pieces/acres of large (20-30" DBH) down logs. For all other VCU's within these five provinces, the following structure will be retained in harvest units in high value marten habitat. Approximately 10-20 percent of original stand structure will be retained with an average of 4 large trees/acre (20-30" DBH), an average of 3 large decadent trees/acre (20-30" DBH), and an average of at least 3 pieces/acres of large (20-30" DBH) down logs.

For both the goshawk and marten stand management standards and guidelines above, harvest units under 2 acres do not need to maintain any of the prescribed amounts of forest stand structure. However, to provide for retention of important forest structure, the effective silvicultural rotation is increased to 200 years.

6. Analysis of the Old-Growth Strategy

a. Amount and Distribution of Old-Growth Forest

The first and most prominent feature of the old-growth habitat strategy in the Forest Plan is the substantial amount of productive old-growth forest that will be protected forest-wide in both the matrix allocated to timber management and the reserves (3,551,482 acres in reserves - Appendix 3 and 1,038,492 acres in the matrix - Appendix 8). A total of 84 percent of the productive old growth that was present in 1954 (5,441,557 acres - Appendix 3) would be present in 2095 assuming full implementation of the Forest Plan for 100 years. This is equivalent to an estimated 90 percent of existing productive old-growth (5,063,571 acres - Appendix 3).

Within protected reserves, a total of 70 percent (3,551,482 acres) of the existing productive old-growth on the Tongass is protected in reserves in “non-development” LUD’s (Appendix 3). Adequate distribution of old growth habitats, and not necessarily the forest-wide total amounts, was a principal element of the VPOP conservation strategy (Suring et al. 1993). The proportion of old-growth protected in reserves varies by biogeographic province, but ranges from 38 percent (Kupreanof/Mitkof Province) to 100 percent (Admiralty and West Chichagof Provinces). Within protected old-growth forests, all volume classes of productive old-growth have been protected as well. High volume old growth generally contains the largest trees and averages 35,000 board feet per acre (Julin and Caouette, 1997). For example, an average of 44 percent of the productive old growth in reserves is high volume, whereas 43 percent of the old growth forest-wide is high volume. The proportion of high volume old growth in reserves in 18 of 21 provinces equals or exceeds the proportion present in the province as a whole (Appendix 3).

The Forest Plan exceeds the minimum strategy recommended by VPOP relative to sustaining viable wildlife populations. While fully integrating the large and medium VPOP HCA’s and the mapping of the small reserves, the Forest Plan protects substantial additional productive old-growth forest to further reduce risks to wildlife viability and enhance protection of biological diversity. For comparison, reserves allocated in the Forest Plan with at least 5,000 contiguous acres of productive old-growth (the minimum productive old-growth requirement for VPOP medium HCA’s) exceed the amount recommended by VPOP by 147 percent forest-wide (Appendix 2). Old-growth allocated to reserves exceeds the amount recommended by VPOP in 20 of 21 biogeographic provinces, ranging from 9 to 460 percent over VPOP recommendations. This comparison is conservative: it does not include old-growth forest in contiguous reserves with less than 5,000 acres of productive old-growth, and does not include the substantial old-growth forest that will remain in areas outside of reserves where timber harvest can occur (see A. 5 b. Matrix Management).

The old growth strategy contains at least one large contiguous reserve relative to the province size in each of the 21 biogeographic provinces across the Tongass to address large scale distribution of large old growth reserves (Appendix 5). Seventeen of the 21 provinces have at least 1 very large reserve (e.g. over 180,000 contiguous acres). For example, in the North Central Prince of Wales Province, a contiguous reserve of 200,584 acres (Honker/Sarkar/Karta) is provided in the Forest Plan -- 5 times larger than a VPOP large HCA (40,000 acres). Two provinces have a large reserve exceeding 75,000 acres; the two remaining provinces are intermediate sized-islands or aggregates of smaller islands and have contiguous reserves of from 30-40,000 acres and virtually all federal lands within the province are in a reserve land allocation (Dall Island and Southern Outer Islands).

High quality old-growth forest has been mapped in the largest reserves as well. The proportion of high volume old growth (used as one indirect measure of old-growth habitat quality) in the largest reserves is equal to or greater than the proportion of high volume old growth throughout the province in 16 of 21 provinces forest-wide (Appendix 5). Many of these reserves previously existed (e.g., Admiralty and Misty

Fiords National Monuments), while others were explicitly created to achieve this objective (South and Central Prince of Wales Island, Kupreanof/Miktof and East Chichagof Island).

The comprehensive old-growth habitat strategy in the Forest Plan also is responsive to the PNW Review recommendation to not further fragment existing blocks of high volume old growth by incorporating many existing roadless areas in reserves. An average of 89 percent (range 55-100 percent in each of 21 biogeographic provinces) of the Tongass is roadless (Appendix 4), an indirect measure of unfragmented (from clearcut harvest) landscapes. An average of 84 percent of the currently roadless acreage on the Tongass is allocated to "non-development" LUD's in the Forest Plan and will thus retain the roadless and unfragmented character of the landscape. A substantial portion of the Tongass will remain roadless and unfragmented in the Forest Plan

PNW Review scientist Pletscher (Kiester and Eckhardt, 1994, p. 147) offered that an "inverse HCA" concept should be considered, in which large protected reserves would dominate the landscape and small "reserves" would be allocated for timber management. One way to examine this concept is the proportion of the existing productive old-growth in each biogeographic province allocated to timber management emphasis. Nineteen of the 21 provinces have equal to or greater than 50 percent of the existing productive old-growth forest allocated to a protective status (Appendix 2), suggestive of an inverse HCA concept. Ten provinces (48 percent) have over 75 percent of the existing productive old growth protected in reserves. Again, high quality old-growth forest has been protected; the proportion of high volume old-growth was generally equal to or greater than the proportion in the total province.

Additional concerns regarding habitat fragmentation were expressed by the VPOP Response that recommended that the 3 largest old-growth forest patches within each ecological province should be protected from logging and roadbuilding. We examined how well the old-growth strategy in the Forest Plan responded to these general recommendations to maintain large blocks of old-growth forest. However, there are various ways to define forest blocks or "patches". Without some patch definition restrictions, virtually all old-growth forest on any island could be considered one contiguous and interconnected patch.

Two analyses were conducted to examine the recommendation regarding preservation of large blocks of old-growth forest. The first examined the concept of contiguous blocks of interior old-growth forest (DeGayner and Iverson, Old Growth Block Inventory, In prep,). Interior forest was defined as greater than 300 feet into the forest from the productive/nonproductive forest edge. The resulting five largest interior forest blocks in each biogeographic province were compared to the Forest Plan land allocations to determine the proportion of these blocks protected in a reserve. Forest-wide, 73 percent of the area of these 5 largest interior old-growth blocks was protected for a total of 476,000 acres (Appendix 6). A small portion of these acres may not longer meet the definition of interior forest acres after full implementation of the Forest Plan for 100 years. The proportion varied by province, from 38 percent protected in the East Baranof Biogeographic Province to 100 percent on West Chichagof, Admiralty, and North and South Misty Fiords Biogeographic Provinces.

A second analysis examined the largest contiguous blocks of only high volume old-growth forest and the proportion protected in reserves in the Forest Plan (Appendix 6). Overall, within a biogeographic province, these high volume blocks were much smaller than the interior forest blocks of all productive old growth (Appendix 6 and Appendix 7). Forest-wide, an average of 83 percent (province range 36 to 100 percent) of the five largest contiguous high volume blocks in each province was protected in reserves for a total of 225,000 acres (Appendix 6). These first two methods of many possible delineations of "large blocks" provided somewhat different results. There is no analysis to support the "3 largest old-growth forest patches" recommendation—certainly nothing compared to the in-depth analysis VPOP contributed in their initial conservation strategy (278 pp.) or the scientific reviews provided by the PNW Review 18 scientists (282 pp.). Nonetheless, the Forest Plan provides substantial (73 to 83 percent) protection to old-growth blocks considered in this analysis.

The allocation of forest stands and landscapes to some form of timber harvest within the matrix does not mean that all trees and stands will be harvested leaving only a continuous "sea of second growth." There are numerous standards and guidelines limiting timber harvest in these matrix lands to protect specific resource and landscape components. An average of at least 57 percent (Appendix 8) of the original (pre-1954) productive old growth in these landscapes (the three timber harvest LUD's) would not be harvested and would remain standing throughout the planning horizon of 100 years, even with application of the maximum allowable timber harvest under the Forest Plan. A total of 69 percent of all existing productive old-growth in the matrix would remain after full plan implementation.

The relative quality of habitat within the three principal features of the matrix, the beach and estuary fringe, riparian habitat management areas, and other lands not available for timber harvest, are identified at both the province (Appendix 9) and VCU (Appendix 10) spatial scales. The beach and estuary fringe accounts for 15 percent of the productive old growth protected in the matrix; riparian habitat accounts for about 24 percent, and the "other lands" account for the remaining 61 percent. As discussed earlier, the proportion of high volume old growth is one measure of habitat quality: the beach fringe averages 45 percent and the riparian areas average 43 percent high volume old-growth forest.

Due to less restrictive management standards in the past, there has been some harvest in these areas: 27,000 acres in the beach and 54,000 acres in the riparian areas forest-wide. The "other" lands not available for timber harvest are not as spatially explicit as the beach and riparian. These include over half a million acres of productive old growth, averaging 31 percent high volume, protected in areas where future timber harvest will otherwise be permitted. Over half of this old growth is below 1,000 feet in elevation, the area where most past timber harvest has occurred. Note that where provinces and VCU's are completely reserved (i.e., where commercial timber harvest is prohibited), such as in semi-remote Recreation or Wilderness LUD's, there is no "matrix" (Appendix 9 and 10).

b. Island Effects

The potential risk to island endemic species that may be closely associated with old-growth forests was evaluated by conducting an analysis of islands of varying sizes (Iverson 1996b) revealed a very low risk to islands ranging in size from 1,000 to 10,000-acres in Southeast Alaska. There are a total of 58 islands of this size range, but only 8 had productive old-growth forest that was suitable for timber harvest in the Forest Plan representing only 2.2 percent of the productive old-growth on these islands (Table 7). However, long-term risk may be elevated on some of these 8 islands considering past as well as potential additional harvest (e.g., Shelikof, Sokolof, Marble, and Orr Islands).

Risks were slightly higher for islands ranging from 10,000-100,000 acres, with 7 of 19 having suitable productive old growth potentially available for harvest. Hecata Island is the largest island in this category (41,000 acres of federal land) with POG suitable for timber harvest. Several of these islands may also have elevated risks due to the cumulative effects of past as well as potential additional harvest (e.g., Tuxekan, Catherine, Suemez, and Hecata Islands. However, most productive old growth (92 percent) and most scheduled for timber harvest (95 percent) occurs on the largest islands exceeding 100,000 acres. The Forest Plan will not add additional risk to islands under 1,000 acres and will minimize risks to islands under 50,000 acres, with a cumulative maximum of 2,100 acres of old-growth forest that may be harvested over the next 100 years. This analysis assumes maximum allowable harvest every decade for 100 years under the Forest Plan. Furthermore, the analysis assumes a potential harvest of nearly 600,000 acres of productive old-growth, whereas only 474,000 acres are actually scheduled for potential harvest.

Table 7.
Analysis of the range of island sizes across the Tongass National Forest and the amount of productive old-growth (POG) at potential risk.[1]

Island Size[2] (acres)	No. of Islands	Total Area	Total POG	No. Islands w/POG Suitable for Harvest	Acres POG	% POG	1995 Second Growth
1-1,000	461	68,807	43,201	0	0	0	3,660
1,001 - 10,000	58	196,503	95,647	8	2,105	2.2	13,659
10,001 -100,000	19	502,271	272,552	7	25,759	9.5	29,710
Over 100,000	19	16,018,366	4,652,201	18	579,064	12.4	356,440
Total	**557**	**16,785,947**	**5,063,601**	**33**	**606,928[(3)]**	**12.0**	**403,469**

1 The proportion of the productive old-growth (POG) that is suitable for timber harvest over the next 100 years in the Forest Plan is a measure of relative risk to potential island endemic taxa that may be associated with old-growth forests.
2 Includes only federal lands.
3 Only 474,000 (80 percent) of these suitable acres are scheduled for harvest over the 100-year planning period.

In recognition of the uncertainty about island endemic species and their vulnerability, the Forest Plan contains a "survey and manage" standard and guideline designed to substantially reduce the risk to endemic mammals on these islands. If surveys indicate the presence of these taxa, proposed projects will be designed to ensure their long-term persistence on the island.

c. Habitat Connectivity

There is general agreement among scientists that habitat connectivity is an important component of a landscape conservation strategy (Kiester and Eckhardt 1994, Lidicker 1995). There is, however, uncertainty regarding how connectivity should be achieved in an integrated conservation strategy: through explicitly designed corridors; by designing larger reserves thereby decreasing dispersal distances and facilitating population interchange; or by using an overall matrix management design (e.g. the "50-40-11" matrix prescription designed to provide marginal foraging habitat between reserves for dispersing northern spotted owls (Thomas et al. 1990)).

In light of the uncertainty regarding a variety of approaches to provide landscape connectivity, a further review and analysis was conducted by the IDT. Thus, the TLMP Revision has incorporated a combination of all three landscape conservation design approaches to address landscape connectivity. It has not relied on a single strategy. Beach and riparian corridors of specific widths have been established that provide significant within-island habitat connectivity; habitat reserves have been enlarged (see Old-Growth Habitat Reserves above) often minimizing dispersal distances between many reserves; and standards and guidelines that govern management of the matrix outside reserves (including beach and riparian buffers) contribute to retaining a substantial old-growth forest component to provide connectivity. If site-specific project analyses identify deficiencies in landscape connectivity, the Forest Plan Old Growth Habitat LUD provides the opportunity to re-examine small habitat reserves, which may be adjusted to provide the necessary connectivity (see Small Old-Growth Habitat Reserves, below).

An additional approach to achieve landscape connectivity is to use timber harvest practices that retains some forest structure within the stand after harvest. Application of the marten and goshawk stand level management standard and guidelines will contribute to maintenance of potentially important stand structure in landscapes with substantial amounts of even-aged clearcut harvest with little within-stand residual structure. The goshawk management standard and guideline will be applied to the 28 heavily harvested and fragmented VCU's on Prince of Wales Island. The marten standard and guideline will apply in these same 28 VCU's plus an additional 3 VCU's on North and Central POW and 2 VCU's on the Revilla/Cleveland and vicinity province. Since the marten standard and guideline applies to VCU's that currently exceed 33 percent of POG harvested as well as VCU's that will exceed that amount through future projects, this standard and guideline may apply to additional VCU's in the near future. Considering the likely timber harvests in the first decade of forest plan implementation, this management may apply to 1 VCU on East

Chichagof, 37 VCU's on Prince of Wales Island, and 3 VCU's on Revilla/Cleveland province: Retention of this substantial amounts of within-stand structure should serve to minimize the adverse impacts of additional timber harvest.

Another feature of connectivity identified by the PNW Review were critical links or "pinchpoints" connecting major landscapes within islands (Marcot in Kiester and Eckhardt 1994, p. 103). Such pinchpoints must be carefully protected (Kiester and Eckhardt 1994, p. 17). The IDT identified six such landscape pinchpoints, all relatively narrow areas between larger land units where future alterations in habitat could significantly reduce natural connectivity and limit the ability of land-based species to disperse or migrate. These areas and their degree of protection include:

1. The portage between Tenakee Inlet and West Port Frederick on Chichagof Island is a narrow neck of land connecting northeast Chichagof Island to the main body of the rest of the island. This is in the East Chichagof biogeographic province. This area is completely protected with a large old-growth habitat reserve using the Old Growth Habitat LUD.

2. The area connecting Lisianski Inlet with the North Arm of Peril Strait is a narrow region that connects two major portions of Chichagof Island. This area is fully protected as a Legislated LUD II area.

3. The area between Port Camden, Bay of Pillars, and Three-Mile Arm on Kuiu Island (Kuiu Island biogeographic province), a narrow neck of land connecting the northern and eastern part of the island to the rest of Kuiu Island. This area is protected with the Old Growth Habitat LUD through a combination of several adjacent small old growth habitat reserves.

4. The narrow area between Lindenburg Peninsula and the remainder of Kupreanof Island is largely protected by the Petersburg Creek Duncan Salt Chuck Wilderness. The remaining small area not included in the Wilderness between Portage Bay and Duncan Salt Chuck is primarily peatland; the 1,000-foot beach fringe provides additional connectivity.

5. The Neck Lake area between Whale Passage and El Capitan Passage on Prince of Wales Island (North Central Prince of Wales biogeographic province) has had significant past and on-going forest management activities. It also is a relatively narrow piece of land connecting the extreme northern end of Prince of Wales Island to the remainder of the island. A cross-island connection is nearly protected with a small reserve around Neck Lake and fully protected further south with the very large natural setting reserve around Sarkar Lakes. Connectivity is also provided on both sides of the narrow pinchpoint with the 1,000-foot beach fringe corridor.

6. Sulzer Portage is between West Arm Cholmondeley Sound and Portage Bay at the head of Hetta Inlet on Prince of Wales Island. This relatively narrow neck of land joins the southeast part of Prince of Wales Island to the remainder of the island, connecting North Central and South Prince of Wales biogeographic provinces. This area has had considerable timber harvesting on both National Forest and adjacent private lands. Due to a recent transfer of land ownership the area is now all private land, dividing the northcentral and south portions of Prince of Wales Island with a non-National Forest strip 1-2 miles wide. Continued timber harvesting is anticipated on these private lands, with the potential of creating dispersal barriers. However, clearcuts and advanced second growth forests (50-100 years old) are unlikely to create complete barriers to movement for deer, wolves, marten and squirrels or other species of concern.

d. Identification and Mapping of Old-Growth Forest Reserves

The focus of most wildlife conservation measures in this strategy is the productive old-growth forest component of the terrestrial ecosystem. The Land and Timber Type map (TIMTYP) was used to quantify the abundance of productive old-growth and to identify old-growth reserves. Lands mapped as productive old-growth met two criteria. First, they had to qualify as productive forest, defined as stands of commercial value capable of producing at least 20 cubic feet of wood fiber per acre per year or has 8,000 board feet/per acre and has at least 10 percent tree cover. The second criterion was that the land be classified as old-growth sawtimber. This is one of the four size classes defined for the Tongass TIMTYP forest inventory. Among other items, such as volume class, stand stocking, and stand decadence rating; this inventory breaks the productive forest into four size classes:

1. seedling and sapling, under 5" diameter at breast height (DBH)
2. pole timber; 5"-9" DBH
3. young-growth sawtimber; 9"+ and less than 150 years old.
4. old-growth sawtimber; 9" DBH and over 150 years

These classes were identified for the TIMTYP inventory using aerial photo interpretation. Tree heights and canopy characteristics were the primary size class interpretation criteria. Actual tree age was not a mapping criterion and age was inferred from other stand features. Generally, the size class 4 stands were identified by high tree-to-tree variation in canopy size, an uneven or coarse canopy structure, and the presence of large trees. These features are indicative of old-growth forest characteristics that also includes a multilayered canopy, large trees for the site, large standing and down trees, and multiple age classes. For the Forest Plan analyses, size class 4 stands are used to identify productive old-growth forest. This is a reasonable assumption for the following reasons:

1. Stands that are at or near the age of 150 years of age are relatively rare on the Tongass, so the average age of stands classified as size class 4 is much greater than 150 years. Farr et al. (1976) examined 1,234 trees 11.0" Dhabi and larger. They found average age at breast height to be 282 years old in mixed hemlock/spruce stands. Three trees were greater than 600 years old. The oldest tree in the study was 775 years old. Due to natural disturbance factors (heart rot, insects, wind) this study indicated that trees over 500 years old are not common.

2. The majority of the size class 4 stands are also mapped as wellstocked and as having a high decadence rating. This indicates that these stands are relatively old, uneven aged, and contain old growth characteristics. For example, annual tree mortality exceeded by nearly 3 times the annual growth for the 1.2 million acres of timber lands on the Stikine area (Rogers and van Hees, 1984).

The map of old-growth developed for the Tongass reveals that expansive, contiguous stands of productive old-growth occur only rarely. The forest is generally a mosaic of many forest types and volume classes with significant within stand heterogeneity. Because of the variable nature of the landscape it is not possible to map large reserves of pure or nearly pure productive old-growth forest. Rather, large reserves tend to reflect the overall composition of the landscape, especially high volume old growth. Biologically, mapping entire landscapes has the advantage of including the full range of ecological conditions present in an area. Such large reserves, mapped at the landscape scale, are more likely to support a greater array of the life history requirements of species and to fully represent the elements of biodiversity. Creating reserves around individual old-growth stands might increase the proportion of high volume productive old-growth in the reserves, but would not necessarily accomplish the objectives of providing for species viability and diversity.

Efforts were made to map reserves that contained as high a proportion of productive old-growth forest as possible given the other criteria (size and spacing) of the reserve system. The resulting mapped reserves incorporated the largest remaining intact old-growth blocks, and they were on average superior to surrounding landscapes when comparing the proportion of high volume old growth.

7. Summary

In summary, the IDT concluded that the original VPOP strategy was a sound and effective landscape approach to address the long-term conservation of old-growth associated wildlife species. VPOP used a coarse filter conservation planning approach to develop a comprehensive, multi-scale landscape conservation strategy. They incorporated the entire community of old-growth associated species into their analysis and focused on those species with the greatest viability or distribution concerns in the development of their strategy. Additional scientific information, such as conservation assessments and recommendations contained in the PNW Review, have been incorporated in the Forest Plan to further strengthen the original VPOP strategy. The VPOP Response was considered as a brief “initial response” of some possible considerations that may have been integrated into a final report. While VPOP Response recommendations have not been explicitly incorporated, many of the elements of the VPOP Response have been addressed in concept in the Forest Plan (wider corridors, larger reserves, protection of high volume old-growth, etc.).

The old-growth habitat conservation strategy in the Forest Plan was carefully crafted in response to these fundamental conservation planning documents. Based upon an consideration of the best available information related to conservation planning, the Forest Plan provides a sufficient amount and distribution of habitat to maintain viable populations of old-growth associated species after 100 years of Plan implementation. Due largely to uncertainty, the Forest Plan does not, however, represent a “no risk” conservation strategy; rather it represents a balance of wildlife conservation measures that consider the best available scientific information and reflect an acceptable level of risk for continued species viability.

B. Alexander Archipelago Wolf

1. Introduction

An interagency conservation assessment, *The Alexander Archipelago Wolf: A Conservation Assessment* (Person et al. 1996) (Wolf Assessment), was developed mutually by the Alaska Department of Fish and Game (ADF&G), Forest Service (FS), and Fish and Wildlife Service (FWS) to synthesize the best available information on this wolf subspecies and to address wolf conservation. Using the major findings contained within the Wolf Assessment as a benchmark for analysis, we conclude that the Forest Plan provides habitat conservation elements that will result in a high likelihood of maintaining habitat to sustain viable wolf populations in Southeast Alaska.

The Wolf Assessment identifies three principle management considerations to address both near-term and long-term wolf viability: 1) long-term deer habitat capability; 2) habitat reserves; and 3) wolf mortality management. Wolves occur on the mainland and on the islands of Southeast Alaska, except for Admiralty, Baranof and Chichagof Islands. The greatest potential concerns exist in two areas with large amounts of past and current timber harvest and road construction. The first is Prince of Wales (POW) and Kosciusko Islands in ADF&G Game Management Unit (GMU) 2 and the second is on Kuiu, Kupreanof, and Mitkof Islands in GMU 3. These two areas were the focus or our wolf viability analysis. There is limited reference to other literature given the comprehensive nature of the Wolf Assessment.

2. Deer Habitat Capability

Sitka black-tailed deer are the principal prey of Alexander Archipelago wolves and long-term viability of wolves is directly related to long-term deer habitat capability, a point of common agreement among members of the Wolf Assessment Panel (Iverson 1996d) and Person et al. (1996). Timber harvest of important deer winter range reduces deer habitat capability (Suring et al. 1993, DeGayner 1996). Fragmentation of deer habitats also may increase deer vulnerability to predators, especially in winters of heavy snowfall (McCullough in Kiester and Eckhardt, 1994, p.119). However, after a review of deer habitat relationships, the Deer Assessment Panel did not include “patch size” as a variable practical for the development of a deer habitat capability model (DeGayner, 1995). Further, “patch size” was not suggested to be added as a variable during the subsequent interagency deer model workshops (DeGayner 1996). The deer model primarily addresses deer forage biomass and associated factors affecting forage availability (forest type, elevation, aspect, canopy show interception capability, etc.). Patch size may affect wolf predation rates (increased predation efficiency); however, predation does not influence deer vegetation habitat capability, only the potential number of deer ultimately available to humans.

To estimate long-term deer habitat capability for the Forest Plan, the interagency deer habitat capability model was applied. The model was originally developed by Suring et al. (1988). This model was evaluated and revised during the Deer Panel Assessment meeting (DeGayner 1995). It was again reviewed and jointly revised during interagency (FWS, ADF&G and FS) meetings in May 1996 (DeGayner 1996). In general, the model assumes that winter habitat is limiting and that lower elevations and southerly aspects have the highest habitat capabilities, particularly in heavy snow regions of Southeast Alaska. Stand level features considered important for deer winter range include an abundance of understory forage and a canopy structure capable of intercepting snow so that forage remains available during deep snow conditions. Stands considered as important deer winter range have a net volume of at least 20,000 (Hanley and Rose 1987) to 25,000 (Kirchhoff and Schoen 1987) board feet/acre. These stand volumes are represented in *both* the medium (average = 25,000 board/acre) and high (average = 35,000 board feet/acre) volume strata used in the Forest Plan and this report.

Using this revised model, current deer habitat capability was estimated, as was the capability in year 2095 after full implementation of the Forest Plan for 100 years. *The habitat capability model only estimates relative long-term habitat carrying capacity, and although this is expressed as number of deer, it is not an estimate of actual deer populations*. Habitat is only one of many factors that determine actual deer populations. Actual deer populations are subject to factors other than habitat such as severe winters, disease, predation, and hunting. While some uncertainty associated with the interagency deer habitat capability model exists, it presently represents the best scientifically-based tool available to estimate effects of management activities on deer habitat.

Immediate concerns focus on the cumulative effects of past timber harvest on the reduction in deer habitat capability on POW/Kosciusko Islands, where modeled deer habitat capability has declined over 20 percent since 1954 in 12 of 25 ADF&G Wildlife Analysis Areas (WAA's) (Appendix 12). In 3 WAA's capability has declined over 40 percent (Appendix 12).

Analysis of the deer habitat capability factor, assuming maximum allowable timber harvest every decade for 100 years of implementation of the Forest Plan, suggests that this factor leads to a relatively low risk to wolves. Kirchhoff (1993) recommended that a long-term carrying capacity of 5 deer/mile^2 was necessary to sustain a deer/wolf equilibrium in GMU 2. This estimate was revised by Person et al. (1996), who suggested that an average long-term carrying capacity of 13 deer/mile^2 would reduce long-term risks to wolf viability, sustain wolves, and maintain current levels of deer harvest by humans. Deer densities less than 13 deer/mile^2 but greater than 5 deer/mile^2 may indicate that wolves are viable but that human deer harvest could decline.

Of the 25 WAA's on POW/Kosciusko Islands, the deer habitat capability model estimated that the Forest Plan would support 13 deer/mile^2 in 20 WAA's in 2095 (Appendix 12). Of the 18 WAA's on Kuiu/Kupreanof/ Mitkof Islands, 14 WAA's would support at least 13 deer/mi^2 assuming maximum allowable timber harvest every decade for 100 years. Thus model outputs indicate that 34 of the 43 WAA's in the region of some concern for wolf viability in Southeast Alaska (portions of GMU 2 and 3 identified above) will maintain long-term (100 years) deer habitat that is likely to both support wolves and current human deer harvest. Model outputs for the same regions in 2095 also indicate that all 43 WAA's would maintain habitat capable of producing at least 5 deer/mile^2 and thus maintain current wolf populations. Note that 6 of the 9 WAA's that will support less than 13 deer/mile^2 in 2095 are not capable of supporting this estimated habitat capability density in 1995 (Appendix 12). We conclude that either these WAA's are currently at increased risk of not sustaining current wolf populations or current human deer harvest levels or both.

Furthermore, the Wolf Assessment concluded that sustaining the current estimated wolf population on POW/Kosciusko Island would require a deer population of from 42,500 to 54,000 for a 95 percent probability of equilibrium given current human deer harvest levels. The current estimated deer habitat capability on POW/Kosciusko is 48,743 (Appendix 12), within 10 percent of the 55,000 habitat capability reported in the Wolf Assessment using an earlier version of the interagency deer model. The estimated deer habitat capability on POW/Kosciusko projected for 2095 is 42,045 (Appendix 12), essentially the lower estimate of deer populations necessary to support the current wolf population, current wolf harvest, and current human deer harvest levels. This analysis conservatively assumes no deer habitat capability on private, state, or municipal lands, thereby probably underestimating the actual habitat capability for many landscapes.

The estimates of deer habitat capability from the interagency model (deer/mile^2) are generally comparable to or less than published estimated densities of other black-tailed deer populations in coastal forests of northwestern North America (Table 8). For example, the estimated current capability of deer on POW/Kosciusko island is 19 deer/mile^2 and is less than densities typically reported in the literature. Many WAA's have reduced estimated deer density (habitat capability) due to past timber harvest. However, even relatively unfragmented and unroaded WAA's, such as in Honker Divide (WAA 1319) on central POW Island, have an estimated habitat capability of 20 deer/mile^2 which is well below published estimates. Note, however, that the deer habitat capability estimates do not have any estimate of variability.

Table 8.
Comparison of estimated densities of black-tailed deer in various locations within the coastal forests of British Columbia and Alaska with Tongass National Forest interagency deer habitat capability model estimates.

Location	Deer/mile^2	Conditions	Source
		Reported Deer Density	
Northern Southeast Alaska	32	Mostly < 800 feet elevation, old-growth forest	Wallmo and Schoen, 1980
Finger Mountain, Chichagof Island, Southeast Alaska	89	Mostly < 800 feet elevation, old-growth forest	Kirchhoff, 1994
Northern Vancouver Island	75-150	Coastal old-growth forest	Smith and Davies, 1975 (in Herbert, 1979)
East coast and central and northern Vancouver Island	25 -- 60	Mature coastal forest	Herbert, 1979
Nanaimo River Watershed, Vancouver Island	49	Mosaic of old-growth and early successional coastal forest	McNay and Doyle, 1987
		Deer model estimated habitat capability	
POW/Kosciusko Island (most of GMU 2)	19[(1)]	Mosaic of old-growth and early successional forest; > 75 percent of original old-growth remaining.	Appendix 12. 1995 habitat capability estimate
Kuiu, Kupreanof, Mitkof Islands (most of GMU 3)	21[(1)]	Mosaic of old-growth and early successional forest; > 90 percent of original old-growth remaining.	Appendix 12. 1995 habitat capability estimate

[1] includes a 36 percent reduction for the effect of wolves

The Forest Plan provides for maintaining deer habitat capability sufficient to sustain both wolf populations and current levels of human deer use. The plan guideline, which is generally 13 deer/mi^2 where deer are the principal prey of wolves (based upon Person et al. 1996 as described above), should preclude declines in deer habitat capability that would adversely affect the equilibrium. However, other factors in addition to habitat may affect the current equilibrium including changes in wolf harvest or human harvest of the deer resource. Because deer model outputs have not been validated through research and the equilibrium level of 13 deer/mi^2 is a professional working hypothesis, this TLMP Revision analysis indicates areas of potential concerns relative to the current situation rather than an absolute management threshold.

Wolf populations appear to be more resilient in GMU 3 than GMU 2 and may possibly persist under relatively low deer densities. Deer model results for three of the WAA's on Kupreanof Island show that these WAA's do not currently support the estimated minimum level of 13 deer/mile^2 and yet they apparently support a viable wolf population. Furthermore, wolves persisted in this region (GMU 3) through the consecutive severe winters from 1969-1972 and resulting extremely low deer densities in the 1970's and early 1980s, and have survived over 50 years of bounties paid for all wolves taken in the region (ADF&G 1996). Furthermore, Smith et al. (1986) reported that 78 of 80 wolf scats located near the den of a wolf pack on Revilla Island were dominated by beaver hair and bones and that 70 percent of telemetry relocations were within the vicinity of active beaver colonies. Apparent wolf population resiliency may in part be explained by a more diverse prey base on the mainland (Person et al. 1996) and possibly in GMU 3, one less directly related to deer abundance. Thus, the estimate of 13 deer/mile^2 level from Person et al. (1996) may be primarily applicable to POW/Kosciusko Islands where the data originated to conduct the analysis.

The estimated ability of the Forest Plan to provide deer habitat to sustain wolf populations on POW/Kosciusko Islands and current levels of human harvest of deer is conservative for the following reasons:

a. Estimated deer habitat capability numbers (Appendix 12) are reduced 36 percent where wolves occur to account for wolf predation, e.g., the portion of the deer habitat capability (component of the deer population) consumed by wolves (DeGayner 1996). These reduced deer densities are then used to assess areas that support at least 13 deer/mile^2, a density estimated necessary to support both wolves and human deer harvest. Using this approach, wolf deer prey needs have been provided for twice: once in the 36 percent reduction in density and once in the 13 deer/mile^2 density estimate.

b. The deer model estimates long-term deer habitat carrying capacity and assumes that winter range is the limiting factor to deer populations in Southeast Alaska. Thus, deer habitat capability is essentially the population that could be sustained each year through the most restricted period of the year, generally mid-to-late winter. The model does not consider annual deer demographics and does not include the ‘annual increment’ of annual spring fawn production that may represent a 20-40 percent increase in population size until mid-to-late winter. This deer biomass is available to wolves essentially throughout the year but is not represented in the above analysis.

c. Habitat capability from non-federal land is not included in the estimated density estimates as a worst case analysis, thereby understating the actual habitat capability available to wolves. Appendix 12 displays the abundance of non-federal lands and the estimated deer habitat capability in each WAA.

d. The 13 deer/mile^2 level provides for both wolf viability and current levels of human deer harvest. Deer densities may have to be much lower to trigger a viability concern if human deer harvest rates decline.

e. The estimated deer densities generated by the deer model are less than those reported as actual densities in similar habitat, thereby making it likely that we are underestimating deer habitat capability.

In conclusion, maintaining habitat to support current relatively high wolf populations and current human deer harvest is unlikely a viability issue for wolves. This analysis indicates that after 100 years of implementation of the Forest Plan, at least 80 percent of the WAA’s on POW/Kosciusko and Kuiu/Kupreanof/ Mitkof will have estimated deer habitat capability densities that meet or exceed 13 deer/mile^2 Thus, for 20 percent of the WAA’s in this region, there is some elevated risk of either not sustaining current wolf populations (estimated at 250-300 wolves) or current annual levels of human deer harvest or both, and there is a slightly elevated long-term risk that any existing current equilibrium may be disrupted.

In a more recent analysis, Person (1997) clarified that the 13 deer/mile^2 square value published in the Wolf Assessment was predicated upon a deer reproduction rate of 30 percent annually. To achieve this level of annual reproduction, he suggested that the population must be at about 75 percent of carrying capacity. The 13 deer/mile^2 recommendation in the Wolf Assessment equates to 17 deer/mile^2 for a deer population at carrying capacity. Therefore, Person recommends that analyses relying upon habitat capability model outputs relative to the Wolf Assessment equilibrium model should use the recommended 17 deer/mile^2.

The WAA analysis above using the 13 deer/mile^2 was repeated using the recommended 17 deer/mile^2 value. Thirteen of the 25 WAA’s on POW/Kosciusko and 11 of the 18 WAA’s on Kuiu/Kurpreanof/Mitkof will be capable of supporting 17 or more deer/mile^2 mile after 100 years of full forest plan implementation in 2095 based upon deer model outputs (Appendix 12). Thus 24 or 43 WAA’s (56 percent) will have sufficient deer habitat capability in 100 years to maintain the current deer, wolf, and human deer harvest equilibrium; a reduction from the 80 percent of the WAA's that will sustain the equilibrium as identified above.

We note again, however, that using this higher threshold, a total of 11 of 43 WAA's (26 percent) do not currently have habitat to support 17 deer/mile^2. Thus, using Person's revised recommendation to sustain the current equilibrium, there is currently insufficient deer habitat to sustain this new modeled habitat capability threshold in over a quarter of the wolf range in GMU's 2 and 3. As concluded above, either these 11 WAA's are currently at increased risk of not sustaining current wolf populations or current human deer harvest levels or both. Alternatively, variability and uncertainty in the equilibrium model or deer habitat capability may be large enough such that these WAA's may in fact sustain the current equilibrium. Because of variability in model inputs and uncertainty of how close current deer populations are to carrying capacity, this revised recommendation of 17 deer/mile^2 mile, in addition of the lower 13 deer/mile^2, may serve to express a range of relative risk, rather than an absolute threshold necessary to support the current equilibrium.

Deer populations declined significantly in parts of GMU 3 (especially Kuiu, Kupreanof, and Mitkof Islands) from 1969 to 1972 as a result of heavy and long-lasting snowfall; deer hunting was closed for 18 years. Extremely severe winters are apparently periodic and may occur every 15-20 years in Southeast Alaska (Juday 1984). Wolf populations persisted, at least in low densities, in spite of significant deer population declines. Wolves (and perhaps black bears) apparently factored heavily in limiting deer population recovery, which took nearly 20 years in some areas such as Mitkof Island. Other regions of GMU 3 still have low deer densities, well below the carrying capacity (e.g., Kuiu Island) that the existing habitat could support.

The periodic nature of these severe winter events suggests that during the next 10-15 years there is a high likelihood of such an event occurring again in Southeast Alaska. Within the longer 100-year period, perhaps 3-5 such events could be expected. As deer habitat capability is reduced from timber harvest, the magnitude of deer population declines resulting from these events will possibly increase. Population recovery times also may increase and thus could directly affect wolf populations where deer are the primary prey on the islands of GMU 2 and 3. As such, maintenance of long-term deer habitat capability would reduce the frequency and magnitude of periodic reductions in deer populations. Risks to wolves elsewhere within the wolf range in Southeast Alaska (GMU's 1a, b, c or the remainder of 3) are lower because of lower levels of anticipated timber harvest and increased prey diversity. However, continued reductions in deer winter range coupled with the likelihood of another periodic severe winter could increase the likelihood of deer populations declines: these declines could be as dramatic as those experienced in Kuiu/Kupreanof/Mitkof Islands in 1968-1971.

3. Habitat Reserves

The Wolf Assessment (Person et al. 1996) concluded that to reduce long-term risks to wolf viability, large roadless and unfragmented reserves should be established in biogeographic provinces where extensive timber harvesting is planned. An area of approximately 50,000 acres of limited human access and timber harvest per 192,000 acres of landscape was considered necessary to support relatively secure core wolf populations. These more secure wolf populations would provide surplus individuals to disperse and support less secure populations in non-reserved lands within the matrix. Spacing among reserves was not judged a critical criterion due to extensive mobility of wolves. On POW/Kosciusko Island they suggested nine 50,000-acre reserves totaling 437,000 acres. Applying the same design criterion, an estimated seven reserves totaling 350,000 acres would be needed on Mitkof, Kupreanof and Kuiu Islands (representing most of GMU 3). The assessment also concluded that each reserve should have enough high quality habitat to be capable of producing an estimated 18 deer/mile^2.

Biogeographic provinces may not always represent the most meaningful level of ecological stratification relative to wolf ecology, and thus some provinces were not included in this analysis for several reasons: 1) they were not discussed extensively in the Wolf Assessment due to lower viability concerns (e.g., mainland provinces); 2) sustainable wolf packs may not exist in provinces that are aggregates of smaller islands (e.g., Outer Islands); or 3) provinces may be aggregates of intermediate sized islands that may support sustainable wolf populations but are individually smaller than the modeled amount of 192,000 acres (e.g., Wrangell and Zarembo Islands in the Etolin and Vicinity Province). Etolin Island is 219,000 acres and has one contiguous reserve covering 75,695 acres, which exceeds by nearly 50 percent the minimum suggested size of 50,000 acres. However, Zarembo Island is 117,000 acres and Wrangell Island is 134,000 acres, each well below the 192,000-acre identified for a 50,000 acre reserve. Reserves needed for these landscapes are unknown. Because data was available for the POW/Kosciusko region and there were heightened viability concerns there, Person et al. (1996) focused on that region and did not address intermediate sized islands or other biogeographic provinces.

In the portions of GMU 2 and 3 analyzed in detail, the total number of acres in at least 50,000-acre contiguous reserves in the Forest Plan exceeds by 5 percent (POW/Kosciusko) and 8 percent (Kuiu/Kupreanof/Mitkof) the number of acres suggested for that region in the Wolf Assessment (Table 9). In addition, every reserve approaches or exceeds the level of deer habitat capability of 18 deer/mile square as a relative indication of good quality habitat. The reserves are also dispersed throughout these two areas

A few of these reserves represent new Old-growth LUD allocations and may have some roads from previous management activity (e.g., Central POW reserve). Continued use of these roads will be examined using site-specific information, consistent with direction in the Old-growth Habitat LUD and Forest-wide Standards and Guidelines for Wolves.

Table 9.
The number of reserves in portions of Game Management Units 2 (Kosciusko and Prince of Wales Island) and 3 (Kuiu, Mitkof, and Kupreanof Islands) needed, according to Person et al. (1996), to reduce long-term risks to wolf viability.[1]

Area	Reserves needed	Acres needed	Reserves present	Total acres	Deer habitat capability deer/mi^2
Prince of Wales/ Kosciusko	9	437,000	Calder Holdbrook	56,546	22.8
			Honker/Karta	200,584	17.8
			South POW	199,945	21.4
Total				**457,075**	
Kupreanof/Mitkof/Kuiu	7	350,000	Tebenkof/South Kuiu	233,346	29.6
			Petersburg/Salt Chuck Wilderness	91,747	17.3
			East Rocky Pass	52,297	21.2
Total				**377,390**	

[1] Contiguous reserves are listed with their respective total area in acres. The estimated current deer habitat capability is also presented for each reserve.

4. Wolf Mortality

The third consideration relative to wolf viability is any potentially unsustainable human-induced wolf mortality. The Wolf Assessment identified open road access as a contributing factor to excessive mortality, stating that reported wolf kills increased substantially where open road density exceeded 0.7 miles of road per square mile of landscape. Wolf mortality concerns are primarily focused on POW and Kosciusko Island (most of ADF&G GMU 2) due to the relatively high existing road densities that contribute to greater trapping/hunting access. Wolf mortality results from natural events, legal hunting and trapping, and illegal kills. Human access to large portions of the wolf range on POW increases wolf vulnerability to legal and illegal mortality.

GMU 2 deer and wolf populations have been generally increasing since the severe winters in the late 1960's. Legal wolf harvests from hunting and trapping also have increased dramatically in GMU 2 over the last 19 years (Table 10). The average annual legal wolf harvest from 1977/78 to 1981/82 in GMU 2 was 19 and increased nearly five fold to an annual average harvest of 96 wolves from 1991/92 to 1995/96. Similar increases occurred in GMU 3 where an average of 13 wolves was harvested from 1977/78 to 1981/82 and increased to an average of 43 wolves during 1991/92 to 1995/96 (Table 10).

In the remainder of the wolf range from Skagway to Dixon Entrance on the mainland, short-term viability concerns in response to management activities are lower despite lower apparent wolf and deer densities. This difference is due to the generally unroaded nature of the mainland, difficulty of hunter access, minimal past and anticipated future timber harvest, relatively minor anticipated reductions in deer habitat capability, and a more diverse prey base upon which wolves depend. Further, wolf harvest has been relatively stable over past 19 years (Table 10) in GMU 1a, b, and c, at least indirectly suggesting a temporary equilibrium between harvest mortality and net habitat capability. Wolf harvest rates in GMU 3 were low but stable before 1991, but have increased during the last five years, possibly in response to recovering deer populations.

Table 10.
Annual legal wolf harvest from hunting and trapping in Region 1 (Southeast Alaska) during the past 19 years

Year	GMU 2[1]	GMU 3[1]	GMU 1a, b, & c[1]	Total Region 1
1977/78	23	10	42	75
1978/79	10	16	60	86
1979/80	11	16	45	72
1980/81	34	10	44	88
1981/82	19	14	35	68
1982/83	15	17	48	80
1983/84	27	17	59	103
1984/85	43	7	54	104
1985/86	18	9	52	79
1986/87	39	10	63	112
1987/88	55	9	58	122
1988/89	45	10	42	97
1989/90	32	22	82	136
1990/91	66	18	44	128
1991/92	86	51	59	196
1992/93	105	26	62	193
1993/94	103	48	74	225
1994/95	85	54	80	219
1995/96	99	36	67	202

[1] Game Management Unit (GMU) 2 is Prince of Wales and surrounding Islands and GMU 3 is Kuiu, Kupreanof, Mitkof Wrangell, Zarembo and Etolin Islands. GMU 1 is the entire mainland. Data provided by ADF&G.

The Forest Plan contains a forest-wide standard and guideline that outlines a cooperative interagency analysis to identify regions where wolf mortality is apparently excessive. In such areas we would attempt to determine if the mortality is unsustainable and identify the probable causal factors of the excessive mortality. If road access and specific roads are identified as contributing to excessive mortality, then road closures or access management recommendations can be made and actions taken. In addition, seasons, harvest methods and bag limits need to be considered as population management tools by the ADF&G and Federal Subsistence Board as a cooperative approach to managing wolf mortality at a sustainable level.

The Forest Plan, a programmatic forest plan, does not prescribe a rigid open road density limit. The Wolf Assessment Panel recommended not using a specific road density "rule of thumb." This was contrary to Kirchhoff (1993) and Pletscher (1994) who recommended a road density limit of no more than one mile of open road/square mile. Appendix 13 lists WAA's that currently exceed the 0.7 mile road density identified in the Wolf Assessment and the miles of existing road that would have to be closed to reduce road densities to within these identified limits. Establishing a rigid road density level, and arbitrarily closing roads to meet this density, provides no management assurance that wolf conservation objectives would be achieved, and may unnecessarily limit overall public use of an established road system that may otherwise have no specific adverse impact on wolf mortality. Management recommendations for road and access management, if necessary, would result from the site-specific analysis discussed above that would identify a problem requiring a local and cooperative management resolution. Open road densities above or indeed below these referenced densities may be appropriate to effectively manage road-access related wolf mortality. This approach is taken by the Forest Plan.

5. Other Considerations

Both short-term and long-term viability concerns for wolves should be considered in light of a recent review by Fritts and Carbyn (1995) that examined wolf viability and conservation relative to nature reserves. They reviewed information on many wolf populations throughout North America and Europe and concluded that data on survival of actual wolf populations might suggest that wolves are more resilient than is indicated by classic population viability analysis theory. In fact, many populations that they examined were smaller than the estimated populations on POW/Kosciusko Islands and these smaller populations appeared to be stable or increasing. They remained concerned, however, about fringe populations and rare subspecies, especially those located in the southern part of the species' range.

6. Summary

The Forest Plan provides a combination of land allocations and forest-wide standards and guidelines that provides sufficient habitat to maintain viable and well distributed wolf populations on the Tongass for 100 years of application of the Forest Plan. This addresses the requirements of the NFMA regulations and purposes of the Interagency Memorandum of Understanding among the FWS, FS, and ADF&G to conserve species with viability concerns and help prevent the need for listing under the ESA (MOU 1994). This conclusion is based upon the following findings using the Wolf Assessment as a basis of analysis.

a. Habitat reserves in excess of the total indicated in the Wolf Assessment will be maintained on POW/Kosciusko Islands and Kuiu/Kupreanof/Mitkof Islands to provide secure refugia for persistent core wolf packs and increased likelihood of long-term wolf viability. Furthermore, the reserves include high quality old-growth habitat necessary to support the recommended density of 18 deer/mile^2.

b. In our conservative analysis, the deer habitat capability of 13 deer/mile^2, indicated in the Wolf Assessment to sustain the current wolf population that is in apparent equilibrium between current human deer harvest levels and deer habitat capability, is maintained in 80 percent of the WAA's on POW/Kosciusko and Kuiu/Kupreanof/Mitkof in 100 years

c. Wolf mortality and access management will be addressed through a reasoned, site-specific analysis process to be conducted in cooperation with the FWS and ADF&G. This is a standard and guideline in the Forest Plan and solutions may include road access management.

C. Queen Charlotte Goshawk

1. Introduction

An interagency assessment, *The Conservation Assessment for the Northern Goshawk in Southeast Alaska* (Iverson et al. 1996) (Goshawk Assessment) was prepared jointly by the FS, FWS, and ADF&G to synthesize the best available science information regarding goshawk ecology and to understand the conservation status and provide management considerations for long-term sustainable populations of this raptor in Southeast Alaska. The assessment contained results of a comprehensive literature review, goshawk inventories, Tongass goshawk research information, risk analysis and integrated management considerations. This assessment represents the standard of analysis for evaluating the overall landscape management strategy in the Forest Plan relative to sustaining viable goshawk populations.

Based upon the information synthesized in the Goshawk Assessment, implementing the Forest Plan for 100 years will result in a moderately high likelihood of providing the amount and distribution of habitats to sustain long-term well distributed viable populations of goshawks throughout the Tongass. This conclusion is based upon the following analysis at both the landscape and stand level scales: 1) landscapes (VCU's) are examined forest-wide by projecting the abundance of habitat present in 2095, with the assumption that landscapes inconsistent with a 300-year rotation are at elevated risk of not sustaining goshawks, and 2) stand level analyses identify the proportion of goshawk relocation sites and goshawk nest areas that are at risk from timber harvest.

There is limited reference to other literature given the comprehensive nature (including a thorough literature review) of the recent Goshawk Assessment. Brief reference is made to findings of the Goshawk Panel Assessment (Iverson, 1996e).

2. Landscape Level Analysis -- 300-Year Rotation

One of the primary conclusions of the Goshawk Assessment is that if all landscapes were managed using a 300-year rotation schedule on all productive old-growth forests, the resulting set of forest age classes would provide a high likelihood of sustaining well distributed viable goshawk populations across the Tongass. A key finding used to support this conclusion was the significant selection by goshawks of productive old-growth forests (68 percent of all goshawk telemetry relocations) and relatively little use or avoidance (relative to availability) of all other available habitat types. It was also found that goshawks disproportionately use mature sawtimber in the 100-200 year stand age class. Given what is known about goshawk habitat use relative to stand structure, it was concluded that this forest age class was intermediate in value as goshawk habitat and contributes to sustaining goshawks.

There is an important difference between a harvest "rotation" applied to all old growth (an 'ecological' rotation) as a means to express age class distributions within a forested landscape, and a silvicultural timber harvest rotation applied only to suitable acres scheduled for timber harvest. In this analysis we considered an 'ecological' rotation applied to all productive old growth (as in the Goshawk Assessment) because goshawks use a variety of habitats apparently independent of administrative delineations relative to timber harvest capability. Productive old growth habitats not considered available for timber harvest were used by an estimated 46 percent of goshawk relocations (reported in the Goshawk Assessment), and thus the contribution of these habitats must be included in an assessment of overall risk to sustainability of goshawk habitat.

Application of a 300-year 'ecological' rotation generally results in 1/3 of the productive forest landscape in 0-100 year old stands (low value to goshawks), 1/3 in 100-200 year old stands (moderate value to goshawks), and 1/3 in 200-300 or older (old-growth) stands (highest value to goshawks). As described in the Goshawk Assessment, these proportions of habitat within the scale of goshawk use areas (i.e., median home range of approximately 10,000-acres) across a large landscape would provide habitats with a high likelihood of sustaining well distributed populations. The Goshawk Assessment also concluded that habitat reserves are necessary in regions where past timber harvest precluded the opportunity to fully achieve a 300-year ecological rotation.

The concept of extended rotations, like the 300-year rotation, was viewed favorably by members of the Goshawk Assessment Panel for sustaining long-term goshawk habitat (Iverson, 1996e). Panel members, as did authors of the Goshawk Assessment, concluded that maintaining conifer stands in intermediate age stand structure from 100 to 200 years would, in part, supply stand structure for goshawk prey production, and thus goshawk foraging opportunities.

We conducted a risk analysis at the Value Comparison Unit (VCU) level to compare the Forest Plan with this 300-year rotation landscape design; the closer the Forest Plan came to meeting this design, the higher the likelihood of long-term, well distributed goshawk persistence. The proportion of productive old-growth forest remaining in each VCU across the Tongass in 2095 assuming full implementation of the Forest Plan was estimated. The analysis was conducted at the VCU level because the Goshawk Assessment identified this scale as a measure of potentially well-distributed populations and because VCU's generally approximate the size of median adult goshawk use areas (10,000-acres) on the Tongass.

A 300-year ecological rotation results in an average of 3.3 percent of the productive old-growth harvested per decade over the 300-year period. At this 300-year rotation rate of harvest, and accounting for all timber harvest since year 1954, VCU's should have no more than 47 percent (14 decades times 3.3 percent) of the productive old-growth harvested at year 2095. If a VCU exceeds 47 percent harvest in 2095, productive old-growth would have been harvested at a faster rate than that of a 300-year ecological rotation, and possibly result in excessive amounts of early-aged (0-100 years old) forest. According to the Goshawk Assessment, this could result in an increased risk of not sustaining goshawks in that VCU or local landscape. We concluded that up to 33 percent of the productive old-growth in a VCU in early seral forest (0-100 years old) was consistent with a strategy to sustain goshawk habitat based upon a working hypothesis of a 300-year rotation. Those VCU's with between 33 and 47 percent of the total productive old-growth in early seral forest structure represents a slightly increased risk of not supporting goshawks.

To estimate forest-wide risk to goshawks with application of the Forest Plan until the year 2095, the number of VCU's with greater than 47 percent and between 33 and 47 percent of the productive old-growth harvested since 1954 was divided by the number of landscapes (VCU's) across the Tongass that might support goshawks. Many of the 926 VCU's forest-wide are composed largely of unsuitable goshawk habitat, including rock, ice, and peatland. The analysis only included the 678 VCU's that have at least 2,300 acres of productive old-growth forest, an estimate of the minimum amount necessary to support goshawks. This acreage amount was used because the median adult goshawk home range size is 10,000-acres and the least amount of productive old-growth within any goshawk use area reported in the Goshawk Assessment was 23 percent. Under these assumptions, this analysis is considered conservative because it does not include the over 280,000 acres of productive old-growth in 248 VCU's forest-wide having less than 2,300 acres of productive old-growth per VCU. There is a high likelihood that these VCU's collectively support some goshawks.

Using only percentages of productive old-growth harvested may be misleading in some instances, and absolute amounts of productive old-growth may be an important consideration in a VCU-based risk analysis. Specifically, even though a VCU may exceed a certain proportions of productive old-growth harvested (e.g., 33 percent, between 33-47 percent, or greater than 47 percent), the resulting landscape may still contain a substantial total amount of suitable habitat, and thus the overall risk to goshawks may be less. This situation could occur in very large VCU's or VCU's that originally had a substantial proportion of productive old-growth before timber harvest began in 1954. An example is VCU 588. Originally, it had 20,668 acres of productive old-growth and now has 10,942 acres for a 47 percent reduction—yet despite the magnitude of reduction, the 10,942 acres may be sufficient to support goshawks within that VCU. Thus, those VCU's that would contain greater than 6,700 acres of productive old-growth in 2095 were not considered at elevated risk, despite exceeding an absolute proportional level (33 percent or 47 percent), because we assumed they would have sufficient habitat to sustain goshawks. This amount of old-growth is 67 percent (2/3's of a landscape in suitable habitat condition) of the 10,000-acre median goshawk use area size. This is a conservative estimate for two reasons. First, the Goshawk Assessment concluded that up to 1/3 of a landscape may be in an intermediate value stand condition (100-200 years old) and this analysis allocates this 1/3 to high quality productive old-growth forest. Second, the analysis assumes that 100 percent of the use area is productive old-growth, which never occurred (Goshawk Assessment, Appendix 1).

Results of this analysis indicated that a total of 35 VCU's across the forest currently (1995) exceed 33 percent of the productive old-growth harvested. Thus, approximately 5 percent of the range of the goshawk habitat across the entire Tongass (35 of 678 VCU's) is at an elevated risk (e.g., > 33 percent)(Appendix 14). Twenty-six of these 35 VCU's (74 percent) are aggregated in the North Prince of Wales biogeographic province. This finding is consistent with a risk analysis presented in the Goshawk Assessment. No other province among the 21 provinces on the Tongass had more than 3 VCU's with elevated risk, suggesting that any remaining risk is minimally dispersed forest-wide.

Full implementation of the Forest Plan in 2095 would result in 51 VCU's with over 47 percent of the productive old-growth harvested, representing an elevated risk of not maintaining a high likelihood of sustaining habitat to support goshawks across 7.5 percent of the species' range on the Tongass (Appendix 15). Again, most risk occurs on the North Prince of Wales biogeographic province where 29 VCU's (57 percent) exceed a harvest of 47 percent of the productive old-growth. Of the remaining 22 VCU's, no more than 5 that exceed 47 percent occur in one province, indicating a generally dispersed risk across the other 8 provinces forest-wide that have at least 1 VCU in excess of 47 percent of the productive old-growth harvested. An additional 64 VCU's forest-wide (9 percent) would have between 33 and 47 percent of the productive old-growth harvested in 2095, indicating a slightly elevated risk (Appendix 16). Again, most of these VCU's would occur in the North Prince of Wales province (25 VCU's or 39 percent). A total of 10 VCU's (16 percent) would occur in the East Chichagof Island province.

The likelihood of sustaining a satisfactory distribution of habitat at the VCU spatial scale to support goshawks may be reduced in some localized regions where timber harvest in aggregates of VCU's exceeds the habitat capability of a 300-year rotation. This is especially true for the North Prince of Wales Island. However, risks may be compensated by several factors:

a. The Goshawk Assessment concluded that where past timber harvest had exceeded the harvest rate to achieve the age class distribution of a 300-year rotation, large reserves in those landscapes would compensate for the habitat loss due to timber harvest. They also concluded that insufficient information existed to prescribe the design of a reserve-based strategy to sustain goshawks. The Forest Plan does, however, provide at least one very large reserve in each biogeographic province (Appendix 5). In the Prince of Wales Island area, most notable are the Sarkar/Honker Divide/Karta Wilderness reserve that totals over 200,000 acres, the 200,000-acre reserve on South Prince of Wales, and a 56,000-acre reserve at Mt. Calder/Mt. Holbrook on Kosciusko Island. A 40,000-acre HCA generally was considered too small to sustain more than one or two pairs of goshawks by Goshawk Assessment Panel members (Iverson 1996e). The panelists did not judge reserves greater than 40,000 acres. The two 200,000-acre reserves are each 5 times larger than the V-POP recommended large HCA of 40,000-acres and should certainly contribute to goshawk viability. We concluded that, in addition to these very large reserves, other smaller reserves (e.g., 10-50,000 acres, Appendix 2) also should contribute to reducing overall risk to goshawks in localized areas by providing some goshawk habitat.

b. The Forest Plan also contains a specific protective standard and guideline to address goshawk habitat in VCU's where more than 33 percent of the productive old growth forest goshawk foraging habitat has been converted to young conifer stands (i.e. those VCU's that do not meet the effective 300-year rotation). In these VCU's, additional timber harvest units over 2 acres in size must maintain forest stand structure characteristics beneficial to goshawks. These include maintaining an average of 30 percent canopy closure and an average of at least 8 large trees per acre. Where harvest units are less than 2 acres, structural retention is not required, but overall stand removal is limited to the equivalent of a 200 year silvicultural rotation.

c. High quality goshawk habitat is retained in areas where timber harvest is permitted. As discussed above (Old-growth—Matrix), not all acres of productive old-growth in the matrix will be harvested: an average of 57 percent of the original productive old-growth will remain in 100 years. Specifically, standards and guidelines protect riparian areas and the 1,000-foot beach and estuary fringe buffers. These areas are particularly important as goshawk habitat, since riparian habitats receive about 25 percent of all goshawk habitat use as reported in the Goshawk Assessment, and beach fringe areas an average of 15 percent of the total goshawk habitat use.

d. The distribution of reserves will provide habitat for core populations of nesting goshawks. Goshawks can disperse and recolonize habitats within aggregations of greater at-risk landscapes. While no true juvenile dispersal distances are available for Southeast Alaska, we assume population interchange may also be maintained by adult movements between subsequent nesting areas. The Goshawk Assessment reported that four adult female goshawks moved from 2.3 to 26.9 miles between subsequent nesting seasons. ADF&G (1997) reported that six adult females moved an average of about 14 miles between nests. The three large referenced reserves on POW are located such that nearly all matrix habitats outside these reserves and other protected areas are within this reported dispersal distance, thus increasing the likelihood of recolonization of landscapes that may be at elevated risk of currently supporting goshawks.

e. A goshawk nest protection Forest-wide Standard and Guideline protects an area of 100 acres of high volume old growth forest around goshawks nests. This does not represent a comprehensive conservation strategy, but rather serves to conserve identified goshawk nesting habitat sites with different characteristics of stand structure and landscape position. Nest site protection is only one important part of a broader landscape strategy. The Goshawk Assessment also revealed that goshawk nest sites were a nonrandom subset of the landscape with a higher proportion of productive old-growth surrounding the nest. A nesting habitat protection Forest-wide Standard and Guideline serves to protect these local stand level features important to goshawks.

3. Stand Level Analyses—Goshawk Telemetry Relocations and Lands Available for Timber Harvest

Another approach to assess relative long-term risk to goshawk viability is to examine the vulnerability of known goshawk habitats to modifications from timber harvest at the stand scale. In an assessment of the current (1979) Forest Plan, the Goshawk Assessment reported that about 46 percent of goshawk relocations in productive old-growth occurred in sites or stands that were not available for timber harvest (riparian buffers, isolated stands, unstable soils, etc.).

We re-examined the goshawk telemetry relocations reported in the Goshawk Assessment relative to potential timber harvest permitted by land use designations and standards and guidelines in the Forest Plan (Table 11). This analysis is biased towards birds that occur in landscapes allocated to timber harvest because most goshawk nests are discovered during activities related to timber harvest sale preparation, as noted in the Goshawk Assessment. The proportion of goshawk relocations in areas available for timber harvest, and thus at adverse risk to sustaining goshawks, are likely overestimated in this forest-wide estimate of risk to goshawk habitat.

Table 11.
Analysis of goshawk telemetry relocations compared to sites that are available for timber harvest according to the Forest Plan.[1]

	All Bird Relocations			Adult Only Relocations		
	Total	Available for Timber Harvest	Percent Available	Total	Available for Timber Harvest	Percent Available
Development LUD's	1559	202	12.9	1230	179	14.5
Non-development LUD's	801	2	0.2	725	0	0
Total	2360	204	8.6	1955	179	9.1

[1] Radio-marked goshawks were separated into those that were captured and tracked in landscapes allocated predominantly to timber harvest land use designations (development LUD's) (e.g., Prince of Wales Island, Kuiu Island) and those captured and followed predominantly in regions where timber harvest is not permitted (non-development LUD's) (e.g., Juneau and Douglas Island). Available refers to relocations that occurred in sites where timber harvest was permitted.

This analysis revealed that among all goshawk relocations, nearly 91 percent occurred on lands not available for timber harvest. Thus on average, approximately 9 percent of habitats of known use by goshawks may be at risk due to possible timber harvest over the next 100 years. Risk increases to 14.5 percent for adults only captured and monitored in landscapes predominantly allocated to management prescriptions that do not exclude timber harvest. This low risk is consistent with the observation that much of goshawk habitat use occurs in sites that are protected from timber harvest. Nearly 70 percent of all productive old-growth forest is in some form of reserved status where timber harvest is excluded, and an average of 57 percent of the original productive old growth will be sustained in areas where timber harvest will be permitted. Importantly, the Goshawk Assessment reported nearly 40 percent of goshawk relocations occurred in the beach fringe and riparian habitat, areas specifically protected in the Forest Plan.

We also examined the relationship between known goshawk habitat use patterns and the VPOP Response recommendation to fully protect the three largest old-growth reserves in each biogeographic province. This recommendation, while conceptually attractive for other reasons such as biodiversity, has little apparent relationship with goshawk habitat use patterns. A specific 'forest edge' and 'clearcut edge' analysis in the Goshawk Assessment did not detect any significant relationship between these structurally different ecotones and goshawk habitat use patterns. Based upon telemetry relocations, goshawks neither avoided nor selected these two ecotones, suggesting they may not be sensitive to the difference between natural forest edge and that caused by timber harvest. Further analysis of 'interior' versus 'edge' forest did not detect any selection or avoidance for interior old-growth forest (defined as greater than 300 feet from a forest edge). Based upon results reported in the Goshawk Assessment, protection of the three largest old-growth forest patches would not substantially contribute to critical landscape features important to goshawk habitat use (as compared to selection for beach and riparian habitats that may be prey rich, versus possibly less diverse interior forest conditions).

The spatial relationship between the five largest interior old-growth forest patches in each biogeographic province (Appendix 6) was examined relative to goshawk telemetry relocations (Goshawk Assessment). Forest-wide, only 7 percent (174 of a total of 2,363) of all goshawk relocations occurred within these forest interior old-growth blocks. For comparison, nearly 13 percent of the productive old growth across the Tongass occurs within the entire sample of interior old growth blocks (Appendix 6). This analysis is generally consistent with findings in the Goshawk Assessment that goshawks apparently do not select for interior portions of large blocks of old-growth forest. Based upon these data, the largest interior blocks of old-growth forest do not appear to provide a significant contribution to a goshawk habitat conservation strategy.

4. Goshawk Nesting Habitat

The second component of the stand level analysis was to examine past timber harvest at various spatial scales around known goshawk nests. We also examined additional future risk to known goshawk nesting areas compared to land allocations and standards and guidelines in the Forest Plan. The sample of 36 known goshawk nest areas in Southeast Alaska referenced in the Goshawk Assessment was used for this analysis. As concluded in the Goshawk Assessment, this sample of nests is biased towards goshawks discovered in landscapes predominantly allocated to timber management and may not necessarily be representative of the entire goshawk population in Southeast Alaska.

Relatively little productive old growth has been harvested around known goshawk nests. The proportion harvested increased with distance from the nest, with 3 percent (range 0 -- 50 percent) within the ¼ mile radius (radius area = 140 acres), 12 percent (range 0 -- 57 percent) within a 1-mile radius (radius area = 2040 acres), and 14 percent (range 0 -- 61 percent) within a 3-mile radius (radius area = 18,000 acres) (Appendix 17). Only 2 of 36 nests (6 percent) had any harvest within the 140-acre area around the nest and only 60 acres within the ¼ mile radius had been harvested after the nest was discovered. Forest Service management direction has generally prohibited harvest within this small region around known goshawk nests (USDA Forest Service 1992). Similarly, only 160 acres at 3 nests has been harvested within a 1-mile radius once the nest was located.

There is substantial protection of old growth habitats around known goshawk nests resulting from land allocations in the Forest Plan. A total of 20 of 36 (56 percent) known goshawk nest sites occur in a protected natural setting LUD in the Forest Plan (Appendix 18). Nearly 40 percent of the entire area of all three spatial analysis areas (1/4, 1, and 3 mile radii from the nest) would be protected in a reserve in the Forest Plan, despite being a biased sample toward landscapes predominantly allocated to timber harvest. This compares to the estimated 70 percent forest-wide average of all productive old growth that will be protected in reserves. This analysis includes only those lands protected in a reserve status, and does not include the proportion of old growth that would remain in the matrix lands (see above), an average of 57 percent of the original productive old growth.

5. Evaluation of Cumulative Effects of Non-Federal Ownerships

There are nearly 950,000 acres of state, municipal and private lands in Southeast Alaska (not including Glacier Bay National Park). This represents approximately 5 percent of the total land acreage of Southeast Alaska. The ability of these lands to provide goshawk habitat is generally unknown, which makes factoring in the effects of non-federal lands on overall goshawk viability difficult.

In this analysis (and other previous work developed for the TLMP Revision), the effects of non-Federal lands were considered in several ways: 1) the stand level nest site buffer analysis described above adopted a scenario which assumed all non-Federal lands would be subjected to timber harvest; 2) virtually all goshawk telemetry relocations on non-Federal land occurred in the Juneau-Douglas area and these lands were assumed to be in a natural setting habitat condition; and 3) the VCU by VCU long-term risk analysis was an index of goshawk habitat and risks solely for Tongass National Forest lands.

The conclusion of this analysis is that there is, and should continue to be, sufficient habitat on Federal lands well-distributed across the Tongass in 100 years to attain a moderately high likelihood of sustaining viable goshawk populations. With only 5 percent of Southeast Alaska in non-Federal ownership, there is little reason to alter this conclusion. The Goshawk Assessment provided a “crude estimate” of 15-20 percent current reduction in goshawk habitat capability throughout Southeast Alaska considering all ownerships. A generalization may be made that in those biogeographic provinces with little or no long-term risk (no or only a small number of VCU’s exceeding 47 percent of the productive old growth harvested in 2095), there would be little if any additional overall risk from factors attributed to land management activities on non-Federal lands in those provinces. However, in the few provinces with some aggregated risks to goshawk habitats anticipated from potential timber harvest on federal lands (e.g., North Central POW), a high proportion of non-federal land in those provinces (North Central POW, for instance, has 255,000 acres or 17 percent) could add localized risk to goshawks. This further emphasizes the importance of habitat features protected on Federal lands (e.g., beach and riparian buffers and very large reserves in higher risk landscapes). However, again this would not fundamentally alter the conclusion that there is sufficient habitat on Federal lands to maintain well-distributed goshawk populations.

6. Summary

Based upon these analyses, the Forest Plan will provide a sufficient amount and distribution of habitat to maintaining viable and well distributed goshawk populations across the Tongass after 100 years of Forest Plan implementation. These analyses assumed maximum allowable timber harvest every decade for 100 years of implementation of the Forest Plan. This conclusion addresses the NFMA regulations concerning wildlife population viability and purposes of the interagency MOU (MOU, 1994). Several specific analyses support this conclusion:

a. An estimated 95 percent of the goshawk range on the Tongass currently has a high likelihood of sustaining goshawk habitat (< 33 percent of old-growth harvested).

b. An estimated 93 percent of the goshawk range on the Tongass would have less than 47 percent of the productive old growth harvested in 2095, and would maintain a high likelihood of sustaining goshawks.

c. An estimated 9 percent of the goshawk range on the Tongass would have a slightly elevated risk of not having optional habitat for sustaining goshawks, with between 33 and 47 percent of the old-growth harvested in 2095.

d. Most elevated risk landscapes would be aggregated on North Prince of Wales Island. This province only represents 9 percent of the goshawk range on the Tongass.

e. Where risks would be elevated by matrix management intensity, remaining very high quality goshawks habitats would be protected by forest-wide standards and guidelines (Beach and Estuary

Fringe, and Riparian), and very large reserves would be maintained as a compensatory landscape conservation strategy.

f. There is no detectable relationship between the largest interior forest blocks and important goshawk habitat capability.

g. An estimated 85-91 percent of goshawk telemetry relocations occur in sites that would not be at risk from timber harvest.

h. In landscapes allocated to timber harvest, based upon a limited sample of 16 goshawks nests found in areas predominantly allocated to timber harvest, an average of 75 percent (40 percent fully protected as reserves plus an average of 57 percent of the remaining 60 percent subject to timber harvest) of the productive old growth within an area (3-mile radii) around known goshawk nesting areas would receive protection in 100 years in the Forest Plan.

I. In VCU's currently not consistent with a 300-year rotation on Prince of Wales Island, timber harvest will retain within stand forest structure to reduce the adverse effects of even-aged clearcut timber harvest and retain some foraging habitat value for goshawks.

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VI. Appendices

Note: The appendices to Appendix N are not included with this printed version. They are included in the planning record and are available for review upon request.

Appendix 1. Small old-growth reserves in Forest Plan.

Appendix 2. Listing of all contiguous reserves over 5,000 acres by biogeographic provinces in Forest Plan and a comparison with VPOP large and medium Habitat Conservation Area requirements.

Appendix 3. Total productive old-growth forest protected in reserves by each biogeographic province.

Appendix 4. Existing inventoried roadless acres in each biogeographic province.

Appendix 5. List of the single largest contiguous reserve in each biogeographic province.

Appendix 6. Size and composition of the 5 largest contiguous interior old-growth blocks in each biogeographic province and the proportion of each protected in reserves.

Appendix 7. Size of the 5 largest contiguous blocks of high volume old-growth in each biogeographic province and the proportion protected in reserves.

Appendix 8. Amount and composition of productive old-growth forest in the matrix in 1954 and 2095 by biogeographic province.

Appendix 9. Characterization of the productive old-growth forest within the beach, riparian and other lands not suitable for timber harvest in the matrix that will remain in 2095 after full implementation of the Forest Plan by biogeographic province.

Appendix 10. Characterization of the productive old-growth forest within the beach, riparian and other lands not suitable for timber harvest in the matrix that will remain in 2095 after full implementation of the Forest Plan by value comparison unit.

Appendix 11. Old-growth habitat reserve criteria.

Appendix 12. Rough estimates of deer habitat capability densities in 1995 and 2095 by Wildlife Analysis Area.

Appendix 13. Analysis of open road density in Wildlife Analysis Areas within the range of wolves in southeast Alaska.

Appendix 14. Risk analysis of value comparison units with over 33 percent of the original 1954 productive old-growth harvested in 1995.

Appendix 15. Risk analysis of value comparison units with over 47 percent of the original 1954 productive old-growth harvested in 2095

Appendix 16. Risk analysis of value comparison units with between 33 percent and 47 percent of the original 1954 productive old-growth harvested in 2095.

Appendix 17. Analysis of the amount of timber harvested within ¼, 1 and 3 mile radii around goshawk nest areas in southeast Alaska.

Appendix 18. Analysis of habitat protection within ¼, 1 and 3 mile radii around goshawk nest areas in southeast Alaska under the Forest Plan.